QE LABS

OPERATION AND SERVICE MANUAL

ROD-L M100/M500 HI-POT TESTER

Manual Part No. 90001

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ROD-L ELECTRONICS, INC.

1098 HAMILTON CT. • MENLO PARK, CALIFORNIA 94025 • (415) 322 0711

CERTIFICATION

ROD-L certifies that this instrument was thoroughly inspected and tested and found to meet its published specifications when it was shipped from the factory.

WARRANTY AND ASSISTANCE

All ROD-L Electronics' instruments are warranted against defects in materials and workmanship. This warranty applies for one year from date of delivery to the original purchaser. We will repair or replace instruments which prove to be defective during the warranty period provided they are returned to ROD-L Electronics.

For prompt, efficient service of your instrument, send it directly to ROD-L Electronics along with a statement describing the nature of the problem.

A Return Authorization Number must be obtained from ROD-L Electronics before returning any instruments for repair. Transportation must be prepaid. ROD-L Electronics will assume cost of surface transportation when returning equipment to customer. This warranty is void if the instrument has been modified or subject to gross misuse. No other warranty is expressed or implied. ROD-L Electronics is not liable for consequential damages.

OPERATION AND

SERVICE

MANUAL

M100/M500

HIPOT TESTER

ROD-L Electronics, Inc.
1098 Hamilton Court
Menlo Park, CA 94025
(415) 322-0711

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Section 1

INTRODUCTION

1-1. General

This publication provides operating and servicing instructions for the ROD-L Electronics' Models M100AV, BV, and M500AV, BV AC Hipot Testers. It is divided into five sections. Section 1 describes the instruments and lists their specifications. Section 2 is about installation and operation procedures. Section 3 covers theories of operation. Section 4 contains maintenance and service instructions. Section 5 holds the parts lists, and section 6 the diagrams and schematics. Section 7 covers the options.

Models M100AV, M100BV, M500AV, and M500BV AC Hipot Testers are high voltage leakage and breakdown testers. They have safety ground continuity test capability for performance of dielectric withstand tests in accordance with applicable UL, CSA, VDE, BSI, IEC, and similar standards. The M100AV and M500AV tests and displays total current, while the M100BV and M500BV tests and displays total current and the resistive part of the AC current. For further information, see Section 3.

The dielectric withstand test is one of the significant tests required by the certification agencies (UL, CSA, VDE, BSI, IEC) as proof of the ability of a unit to withstand AC power line spikes without becoming a hazard to itself or the user. For example, lightning, drastic load changes, or power line outages can place short duration voltage spikes on power lines of many times the potential of the nominal line voltage.

Safety standards requiring dielectric withstand testing include UL 45, UL 114, UL 478, UL 506-508, UL 544, UL 674, UL 1012, UL 1244 (proposed,) IEC 380, IEC 348, MIL-STD 202, BSI 3361, CSA 22.2 VDE 0806, etc. The specific standard should be consulted for voltage requirements and specific test procedures.

The ROD-L AC Hipot Testers apply high voltage to the Device Under Test (DUT) for a duration of time preset for one to ninety seconds. The DUT plugs into the front panel test connector. Test limits for total current (and for the resistive part of the AC current with BVs) are preset by the user via a rear panel control. If the DUT is defective, automatic circuitry turns off the high voltage, lights the FAIL lamp, and sets off an audible alarm. This Hipot Tester must then be manually reset, meeting UL requirements.)

All models incorporate an automatic solid state shutdown circuit (as opposed to a collapsing field power transformer) to turn off the high voltage within 2 mS after a fault. To prevent turn on surges, the high voltage has an electronically controlled rate of rise.

The TEST cycle is fully automatic, and accidental test initiation is prevented by use of a recessed START switch. For operator safety, a second security CHASSIS GROUND must be connected to a secure low resistance point on the DUT. Without this connection, the Tester will not enter the READY state, and therefore won't begin a TEST. The SAFETY GROUND of the DUT is monitored and tested electronically. If either the SAFETY GROUND or the CHASSIS GROUND SENSE connection fails during the TEST, the Hipot Tester automatically goes into failure operation, i.e., the high voltage is shut down the and there is a visual and audible alarm.

The ROD-L AC Hipot Testers are completely self-contained rugged instruments designed for laboratory and production testing environments. All AC units are very similar in operation and construction. The primary exception is that BV models additionally measure the resistive part of the AC total current. Externally, the BV model has an extra control on the front and rear panels. (Refer to figure 2-2.) Internally, the standard BV has five PCB assemblies, (A2-1, A6-S5, A7AV, A11, A21,) and the standard AV has four PCB assemblies, (A6-S5, A7AV, A11, A21.)

1-2. Equipment Supplied

Shipping contents of the ROD-L Hipot Test System include:

1. ROD-L Hipot Tester, Model M100AV, M100BV, M500AV, or M500BV.
2. Six foot power cord, three pronged.
3. Thirty-six inch long ground cable.
4. Two line input fuses for 230 VAC operation (assuming 115 normal.)
5. ROD-L M100/M500 Hipot Tester Operation and Service Manual.
6. AMP Plug Kit:

   A) AMP Plug (male) 863022-2.
   B) 4 AMP male pins 862796-2.
   C) 4 AMP red "O" rings 862798-2.
   D) AMP cap, threaded 860102-2.
   E) AMP shell, strain relief 862544-2.
   F) AMP Assembly Instructions.

7. A Serial Number Tag which includes a listing of the selected voltage and current options.
8. A Technician Certification.

1-3. Standard Versions of Models

The standard AC Hipot Tester is available with a full scale test voltage of 1500 VAC, 2800 VAC, or 5000 VAC. Depending on the model, standard full scale values for the ammeter are 10, 25, 40, 50, 100, 200, and 333 mA. For the M100 models the maximum

full scale values are 50 mA for the 1500 VAC unit, 40 mA for the 2800 VAC unit, and 25 mA for the 5000 VAC unit. For the M500 model the maximum full scale values are 333 mA for the 1500 VAC unit, 200 mA for the 2800 VAC unit, and 100 mA for the 5000 VAC unit.

1-4. Special Versions of Models

Instruments with nonstandard test voltages and ammeters are considered special versions of the basic models. In these applications, the customer specifies the voltage and ammeter full scale values.

1-5. Identification

The ROD-L AC Hipot Tester's high voltage full scale rating and the ammeter full scale rating are written in the model number code on the serial number label on the rear panel. An example of the model number format is as follows:

M100AVS5-X.X-ZZZ

where X.X represents the full scale kilovolts and ZZZ represents full scale mA of current.

The serial number is a manufacturer identification of the instrument.

1-6. Specifications

Table 1-1 lists the most important electrical, environmental, and physical specifications of the Hipot Testers.

1-7. Safety Features

1. Loss of safety ground terminates the test cycle. 2. No external leads.

3. Recessed START button.

4. Visual and audible alarm at failure. After a fail indication, the unit is completely RESET if no restart is attempted.

5. High voltage lockout requiring manual RESET.

1-8. Typographical Conventions

ALL CAPS are used to denote names used in the schematics or silk-screened on the M488.

"*" is used to denote a voltage active low electrical signal.

"NOTE:" indicates information that you should read before proceeding.

Table 1-1: Specifications

Test Voltage and Current	User specified up to 5000 VAC, 50/60 Hz, 333 mA NOTE: Voltage and current range combinations are detailed in Section 1-3
High Voltage Shutdown	Within 2 milliseconds after a fault is detected (electronic shutdown circuit)
Automatic Test Cycle	1 to 90 seconds
Initial Turn-On Period	Requires 0.5 seconds for safety ground check before start
Safety Ground Continuity	Reject level: 0.5 ohm ±0.1 ohm; operates whenever ground is connected (Low current, 1.0 amp applied)
OUTPUT VOLTAGE Meter Reading	Accurate to ±3% Full Scale
Voltage Monitoring Circuitry	±1.0% through full range
OUTPUT CURRENT Meter Reading	Accurate to ±3% F.S.
Current Monitoring Circuitry	±1.0% through full range
Voltmeter Resolution	Better than 3% F.S
Voltage Circuitry Resolution	Better than 1.0% F.S
Ammeter Resolution	Better than 3% F.S
Current Circuitry Resolution	Better than 1.0% F.S
Input Power	115 or 230 VAC±10%, 44 to 66 Hz at 500 W max. (30 W typical); line input voltage set by 115/230VAC switch on rear panel
Environmental Operating Conditions	0° to 50°C (32° to 122°F)
Physical Color	Mint-gray/Olive-gray
Weight	35 lbs. (15.9 kg) Net 38 lbs. (17.2 kg) Shipped
Dimensions	16 3/4" x 5 1/4" x 13 1/4" (43 x 13 x 34 cm)

Section 2

INSTALLATION AND OPERATION

2-1. General

This section contains the recommended procedure for unpacking, inspection, installation, operation, storage, and reshipment.

2-2. Unpacking and Inspection

Any shipping carton that appears damaged should be unpacked with the carrier's agent present. Inspect the instrument for damage (scratches, dents, broken knobs or meters, etc.) If the instrument is damaged or fails to meet specifications (performance tests, Section 4,) notify the carrier and ROD-L Electronics immediately. Retain the shipping carton and the padding material for the carrier's inspection.

It is also a good idea to keep the shipping carton and padding in the event a machine needs to be stored or shipped.

2-3. Installation

The ROD-L AC Hipot Testers are suitable for either bench or rack mounting. To rack mount the instrument, (Figure 2-1) use Rack Mounting Kit ROD-L Option #15. Order the Rack Mounting Kit from the factory.

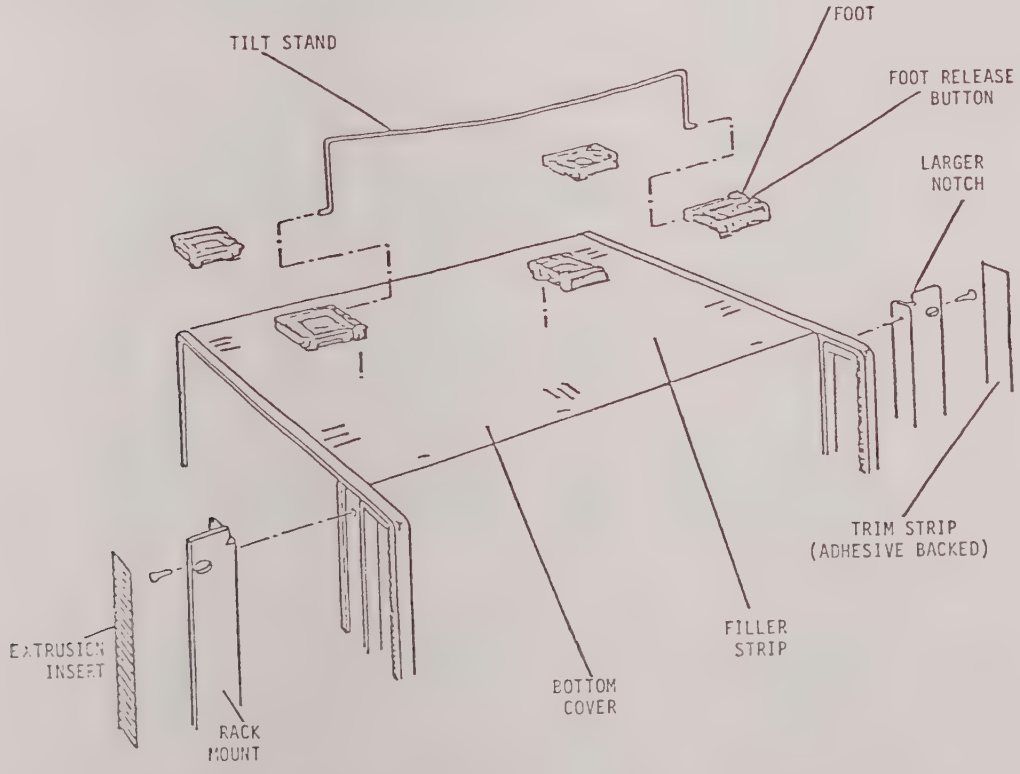


Figure 2-1: Rack Mounting Kit Installation

2-4. Power Requirements

The AC Hipot Tester requires a power source of either 115 or 230 VAC ±10%, 44 to 66 Hz a single-phase. Insure that the power socket to which the tester connects has a functioning safety ground.

2-5. Power Cable

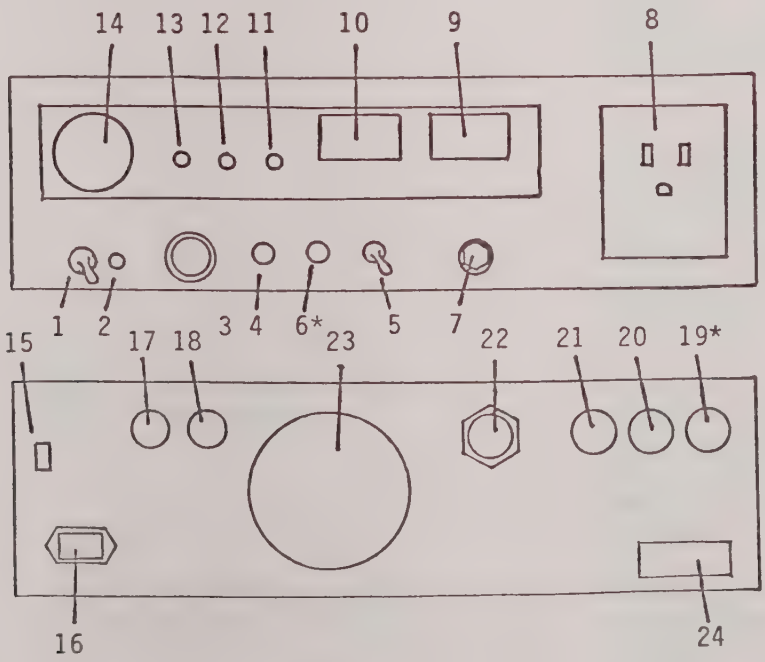
To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cable, which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the three-prong connector is the ground pin.

WARNING

This instrument to be used ONLY in three wire grounded outlets. It is recommended that periodic checks of the outlet and the ground cable be made to insure operator safety.

2-6. Operating Controls

Figure 2-2 illustrates the front panel and rear panel controls for the AC Hipot Testers. Table 2-1 describes the functions of all the controls and indicators.



* BV Model only

Figure 2-2: Controls and Indicators

Table 2-1: Controls and Indicators

REFERENCE	CONTROL/INDICATOR	FUNCTION
1	LINE POWER switch (S1)	Applies/removes the AC line power
2	Line Power lamp (I1)	When lit, indicates that power is applied to the unit, even if fuses are blown or out
3	START push button (S2)	Initiates the testing sequence if the unit is grounded properly and not already indicating a failure
4	RESET push button (S3)	Reinitializes unit: terminating a test early, or resetting a failure
5	TIMING Select Switch A or B (S4)	Selects preset test times and ramp rates assigned to position A and B. Standard factory settings at full scale voltage are: A: RAMP 200V/sec* DWELL 60 sec B: RAMP 200V/sec* DWELL 1 sec * For 5K VAC F.S. Models, the ramp is 500V/sec.
6	REAL PART push button (BV Model only)	Expands the current meter scale by ten to indicate the real part of the AC current flow when depressed during a test
7	CHASSIS GROUND SENSE binding post (BP1)	Connect the chassis of the DUT to this plug (should be low resistance) (36" cable supplied)

Table 2-1: Controls and Indicators (continued)

REFERENCE	CONTROL/INDICATOR	FUNCTION
8	High voltage output block (J1)	Enables application of the test voltage to the DUT
9	OUTPUT VOLTAGE meter (M1)	Indicates AC voltage applied during a test
10	OUTPUT MILLIAMP meter (M2)	Indicates amount of AC leakage current flow (in mA) during a test
11	FAIL Indicator lamp (I4)	Displays warning that DUT failed test
12	TESTING Indicator lamp (I3)	Indicates that a test is in progress
13	READY Indicator lamp (I2)	Indicates that the Hi-pot Tester is ready to start a test; proper ground is established between DUT and Hipot Tester (and acceptable impedance during Ohms Sense test)
14	Audible ALARM (AL1)	Emits a warning sound when a test results in failure
15	115/230 VAC switch (S7)	Selects the line power input voltage
16	AC line power (J3)	Line power receptacle
17	High voltage line FUSE (F2)	High voltage transformer primary circuitry protection: use 2 amp fast blow at 115 VAC and 1 amp fast blow at 230 VAC (unless otherwise noted)

2-7. Safety Features

The safety features built into the ROD-L AC Hipot Testers are as follows:

1. The security CHASSIS GROUND SENSE wire must be connected from the AC Hipot Tester to the chassis or exposed metal of the Device Under Test (DUT) to secure a low resistance point on the DUT. This will allow the READY light to turn on and the AC Hipot Tester to operate. This wire parallels the normal ground wire in the power cord. To insure that both wires are secure, 1 Amp RMS at 1.5 VAC is passed through both wires. If the total path resistance proves greater than .5 ohm, (.1 ohm optional) the READY lamp will not light.

2. A FAIL condition (both the FAIL lamp and audible alarm) occurs and the AC high voltage is removed from the Hipot Tester's HV output connectors within 2 mS after a breakdown occurs. The FAIL condition can be activated if any of the following conditions occur: Real or Total AC current exceeds the preset value; the security CHASSIS GROUND SENSE connection becomes faulty; or an arcing occurs. If a failure is indicated, the DUT did not pass and should be investigated for reason, repaired, and retested.

3. To prevent surges, the AC test voltage is turned on slowly, using electronic circuitry.

4. The START push button is recessed to prevent accidental starting.

5. The RESET push button can be used to prematurely stop the test if desired, and must be used whenever the DUT has failed (unless the AUTO RESET option is installed.)

2-8. Initial Installation and Turn-On

This instrument is shipped ready for 115 VAC operation unless specifically requested by the customer to be set at 230 VAC. Spare fuses are provided for 230 VAC operation.

NOTE: Disconnect the AC Hipot Tester from its power source and insure that the proper fuses are installed and that the 115/230 VAC switch is in the proper position. Otherwise, damage to the instrument may result. Refer to the rear panel of the unit for the proper fuse information.

Prior to applying power to the instrument, perform the following:

1. Set the TOTAL CURRENT control to the full clockwise position.

2. Set the REAL CURRENT control to the full clockwise position (M100BV and M500BV only.)

3. Set the rear panel 115/230V VAC switch to conform with your line voltage.

4. Check that the proper fuses are installed.

5. Connect the 6' power cord to the Hipot Tester and then into the power source.

2-9. Operational Check for Standard AC Hipot Testers

This is an operator oriented procedure which allows operational check of the ROD-L AC Hipot Tester without test equipment:

1. Set LINE POWER switch to OFF.

2. Connect the 36" ground sense cable to the CHASSIS GROUND SENSE terminal. Attach the aligator clip end to the ROD-L AC Hipot Tester on the metal portion of the handle or chassis. Insure that the grounded power cord of the DUT is plugged into the front panel receptacle of the Hipot Tester.

3. Set the line POWER switch to ON and the AC power lamp should glow. After approximately two seconds, the green READY lamp should light.

4. If the READY lamp does not light, insure that the ground sense connection is secure.

WARNING

High voltage is present at HV output connectors when the TESTING lamp is lit and may be extremely harmful to the operator if contacted.

5. With the READY lamp lit, push the START button (the amber TESTING lamp should light) and quickly disconnect the ground sense cable. The red FAIL lamp should light and the audible alarm should sound. Also, the READY lamp will turn off.

6. Push the RESET button to stop the FAIL indication.

7. Reconnect the ground sense cable as in step 2 and the READY lamp should light.

8. Push the START button. The amber TESTING lamp should light and the OUTPUT VOLTAGE meter should indicate the proper voltage under normal operation, depending on the setting of the variac.

2-10. User Responsibility

The user is responsible for determining the applicable test voltage and test duration for their product in accordance with certification agency (UL, CSA, VDE, BSI, IEC, etc.) requirements. The user also determines the normal total leakage current (or the maximum allowed current) from a representative sample of products under test conditions. From this, the user establishes the maximum total leakage considered acceptable for the device. This, then, is the TOTAL CURRENT FAILURE SETPOINT for the device.

In a similar manner, the REAL CURRENT FAILURE SETPOINT is established for the ROD-L Model BV.

2-11. Total Current Trip Adjustment Procedure

To set the total leakage current trip point for the Device Under Test (DUT), proceed as follows:

1. Set test time per applicable agency specification if different from standard factory setting table (listed in Table 2-1, Reference #5.) See Section 2-13 for adjusting the test time.

2. Set TOTAL CURRENT control fully clockwise.

3. Connect DUT to AC Hipot Tester and start test. Record TOTAL CURRENT reading for DUT.

4. While the high voltage is on, slowly rotate the TOTAL CURRENT potentiometer counter-clockwise until the FAIL lamp and audible alarm are activated.

5. Note the position of the TOTAL CURRENT control potentiometer. This position is proportional to the total current reading on the front panel meter.

6. Calculate the position in which you want to leave the potentiometer using the formula:

$$\text{Setting Desired} = \text{Setting in Step 5} \times \frac{\text{max current acceptable}}{\text{Step 3 measured current}}$$

7. Set the TOTAL CURRENT FAILURE SETPOINT control potentiometer to position calculated above. This control can be used to set a current trip point between a meter full scale reading and approximately 0.05 X F.S.

2-12. Real Current Trip Adjustment Procedure (BV only)

This procedure is identical to that above, except that the REAL CURRENT potentiometer is adjusted and the PUSH FOR REAL CURRENT ÷ 10 push button is depressed to read real current.

2-13. Test Time Adjustment Procedure

The TEST TIME ADJUSTMENT potentiometer is set as outlined in Table 2-1, Reference #5, at the factory. The user should set this control in accordance with the regulatory agency's suggested test time for the Device Under Test (DUT) if different from the standard factory setting. To reset the TEST TIME duration, proceed as follows:

1. Turn off power to the AC Hipot Tester.

2. Remove top cover and locate the TEST TIME ADJUSTMENT potentiometer R37 on the A21 P.C. Board. Set TIMING switch on the front panel to "A."

3. Reapply power to the AC Hipot Tester.

4. With top cover removed from the AC Hipot Tester, use a stopwatch to time the duration of time that the TESTING lamp remains on.

5. By adjusting the TEST TIME ADJUSTMENT potentiometer and timing the TESTING lamp duration with a stopwatch, you should be able to set any duration desired between one and ninety seconds.

6. Set the TIMING switch on the front panel to "B" and set potentiometer R2 on the A21 P.C. Board by repeating steps 4 and 5.

CAUTION

Do not touch any of the other potentiometers on the p.c. boards, otherwise the calibration of the instrument will be voided.

2-14. Automatic Test Procedure

The following procedure assumes the ROD-L AC Hipot Tester has been calibrated and adjusted for normal operation. Proceed as follows:

1. Place the Device Under Test (DUT) next to the Hipot Tester.

2. Plug the power cord of the DUT into the high voltage connector of the Hipot Tester.

3. Connect the GROUND SENSE cable between the DUT and CHASSIS GROUND SENSE terminal of the Hipot Tester. If this ground connection is less than 0.5 ohm, (0.1 ohm optional,) the READY lamp will light.

4. Press the START push button. The TESTING lamp should light. (If the Ohms Sense option is used, refer to Section 7-2.)

WARNING

High voltage is applied to the Device Under Test. Do not touch the DUT power cord or chassis while the TESTING lamp is lit. If you do, extreme shock may result.

5. Check that the OUTPUT VOLTAGE meter indicates the test selected voltage. If voltage is high or low, adjust the VARIAC on the rear panel to compensate.

6. Restart the test. Observe the total current indication. (The BV Model has an additional feature: press the PUSH FOR REAL CURRENT PART ÷ 10 push button to observe the "real part" of the current.) For a normal test, the TESTING lamp will extinguish after a completion of the preset test time duration. If one of the preset current failure setpoints is exceeded, the ground sense

connection is interrupted, or an arcing condition occurs due to dielectric insulation breakdown, the test will automatically abort, giving a failure indication, i.e. the FAIL lamp will light and the audible alarm will sound. The operator must then manually press the RESET push button before a test can be repeated. In the event of a FAIL indication, the operator should investigate carefully to determine which failure occured. For this reason the ammeter should be continuously monitored during the test.

NOTE: At least five seconds must elapse between TURN-ON and the first hipot test, and three seconds must elapse between successive hipot tests, or random FAIL indications will occur.

2-15. Storage

It is strongly recommended that the equipment be packed as if for reshipment. Environmental conditions during storage and reshipment should be as follows:

1. Maximum temperature 167°F (75°C)

2. Minimum temperature -40°F (-40°C)

2-16. Repacking For Shipment

If possible, use the original shipping container and packing materials. Otherwise:

1. Attach a tag to the instrument, giving the following information:

   A) Type of service required.
   B) Instrument model number.
   C) Full serial number.
   D) Return address.

2. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

3. Use plenty of packing material around the instrument and protect the front panel with cardboard. Protect the instrument with 2" rubberized-foam padding placed along all surfaces of the instrument, or with a layer of excelsior about 6" thick packed firmly against all surfaces of the instrument.

4. Use a strong, well-sealed shipping container (350 lb/sq in. bursting test.)

5. Mark the container "FRAGILE--DELICATE INSTRUMENT."

In any correspondence, refer to the instrument by full model number and serial number.

Section 3

THEORY OF OPERATION

3-1. Introduction

This section outlines both the justification for hipot testing and the circuit theory for the M100 and M500 Hipot Testers. Section 3-2 overviews some of the considerations that need to be taken when dealing with dielectric stress tests in product safety; Section 3-3 describes the circuit theory of operation in the Hipot Tester.

3-2. Dielectric Stress Testing

Dielectric Stress at high voltage has become one of the more important tests performed on electrical consumer, commercial and industrial products for product safety approvals by the various regulatory agencies. Primary concern is the ability of a product to withstand a certain amount of high voltage without suffering any breakdown between the input line leads and the chassis of the product. The chassis is usually connected to a third wire (safety ground wire) with the purpose of diverting any leakage or breakdown current away from the user who can be in physical contact with the product.

In addition to withstanding a certain amount of high voltage for a certain time (depending on the type of product), maximum limits of leakage current may be specified at input line voltage for some products.

The dielectric stress test is primarily aimed against the danger of the effects produced by high voltage spikes in the input line produced by lightning, flashover, switching or other control failures in the power system transmission. These effects can eventually damage electrical products or injure the user if the products are not adequately designed, manufactured and tested.

A test at 1500 VAC is required of most instruments having a 115/230 volt switch and for sale in both the U.S. and Europe. However, instruments designed for some different uses may have other requirements.

The Rod-L AC series tester applies a sine wave at 60 Hz or 50 Hz of the required voltage between the two current carrying leads of a Device Under Test (DUT,) (the HOT and NEUTRAL conductors tied together,) and the GROUND conductor of the DUT. An additional SAFETY GROUND connection must be made to insure grounding integrity. The DUT must withstand this application of voltage without displaying indication of deterioration arch-over, sparking, overheating, or other type of failure. An ammeter is provided on the AC series instruments for displaying actual leakage current.

It may be thought that if there is no physical connection

between the AC power line and the chassis of the DUT there can be no current flow. This is not, in general, true. There are always parasitic capacitances and resistances present which allow some current to flow. At 1500 VAC, 60 Hz, every 1770 pF of stray capacitance allows 1 mA of current flow. If a power transformer is contained in the circuit, interwinding leakage capacitances of from 100 pF to 1000 pF are common.

Furthermore, many instruments require capacitors to be connected between the AC power line and chassis to eliminate any RF energy being transmitted through the line cord. The circuit schematic of the DUT should be inspected and leakage current for any capacitors of this type should be computed using this formula:

$$I_C = V_C (2\pi fC)$$

$$= 1500 \times 377 \times C \text{ (at 1500 VAC 60 Hz)}$$

and these currents considered "normal" for that device.

The above formula assumes that the capacitors being tested are "perfect," i.e. linear, and have "zero" dissipation. The real world is never so obliging. Ceramic capacitors (normally used for this purpose) have tolerances of 20% or worse, have very nonlinear I-V responses at high voltages, and have dissipation factors at high voltages of 30% or more. Thus, the actual current flow may be 150% or more of the theoretical flow for that capacitor. Actual currents can only be confirmed by testing a large number of instruments and computing tables of expected and worst-case values. Then, any current above this worst-case value can be considered a cause for rejection.

The BV Tester measures the "real" part of the AC current as well as the total current. Nonlinear operations (sparks, arc-overs, etc.) invariably influence the real part of the current much more than they influence the total current. Thus, these effects can be more easily detected on the BV testers.

Resistive parasitic effects can occur as well. These can be caused by moisture or dust between conductors, rosin or acid flux bridges between PC board traces, leaky insulating materials, and so on. Considerable power can become concentrated in these potential leakage paths. Only 1 mA of current at 1500 volts means that some point must dissipate 1.5 watts of power. That much power concentrated in the very small area of a flux bridge can easily cause a fire hazard.

Real current also flows due to nonideal filter capacitors. The real current flow in a capacitor can be computed by multiplying the capacitor dissipation factor by the total current flow, and, as has been stated, this can be appreciable and very nonlinear. The published low voltage dissipation factors of capacitors gives only a limited projection of what to expect at high voltages, and actual results are invariably high.

3-3. Hipot Theory of Operation

This section describes the functions of the various PC boards as well as the operation of the subsystems contained on each PC board. All of the PC board schematics can be found in Section 6.

3-3.1 Instrument Functional Diagram

Functionally, the AC Hipot Tester is divided into three sections: The HV GENERATOR, the HV CONTROL, and the GENERAL CONTROL. A REMOTE CONTROL option can be added to the system as shown in Figure 3-1.

The HV GENERATOR consists of an AC HV transformer (50/60) Hz) specially designed to provide the high voltage and current needed in hipot testing.

The HV CONTROL contains: the unique solid state HV AMPLITUDE CONTROL and the RAMP UP CONTROL circuitry. The HV AMPLITUDE CONTROL operates under the principle of generating an adjustable amount of blocking voltage to the input line voltage coming from the variac as shown in Figure 3-2.

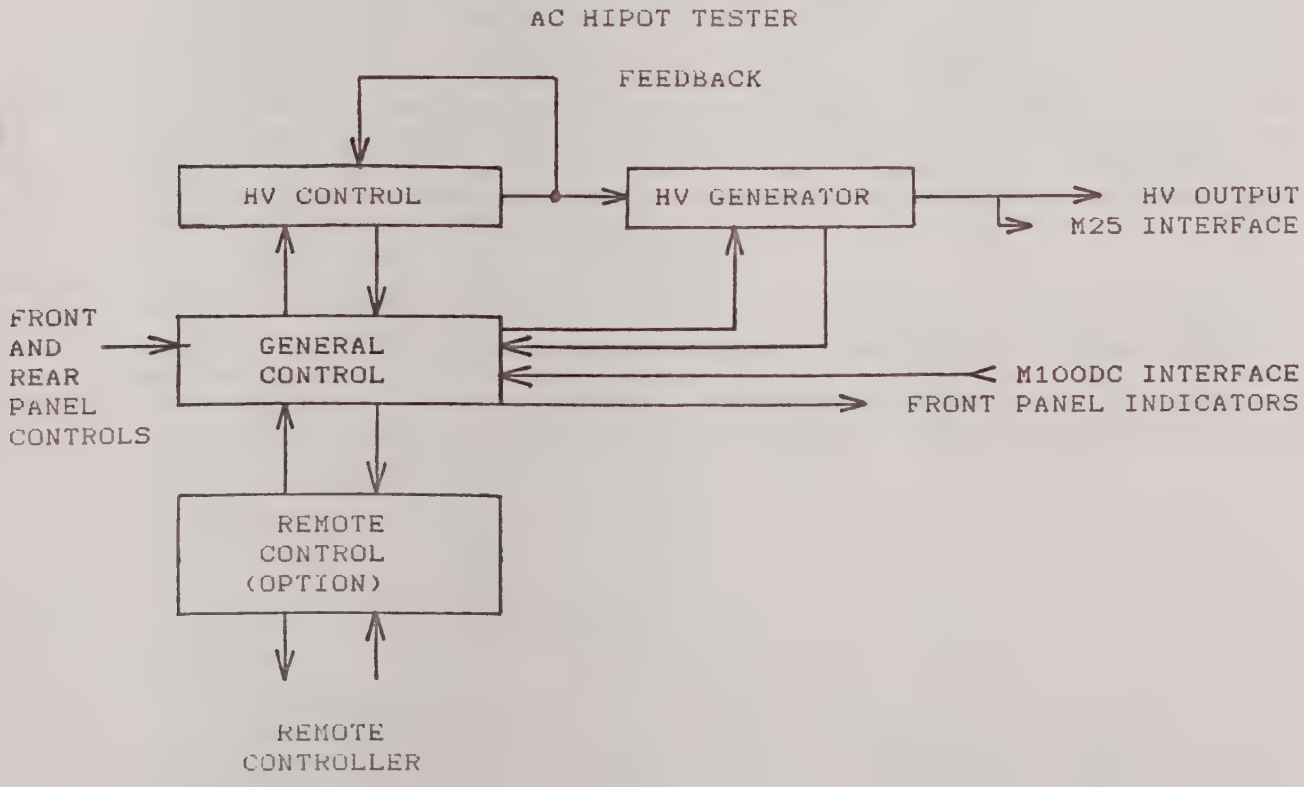


Figure 3-1: Functional Diagram

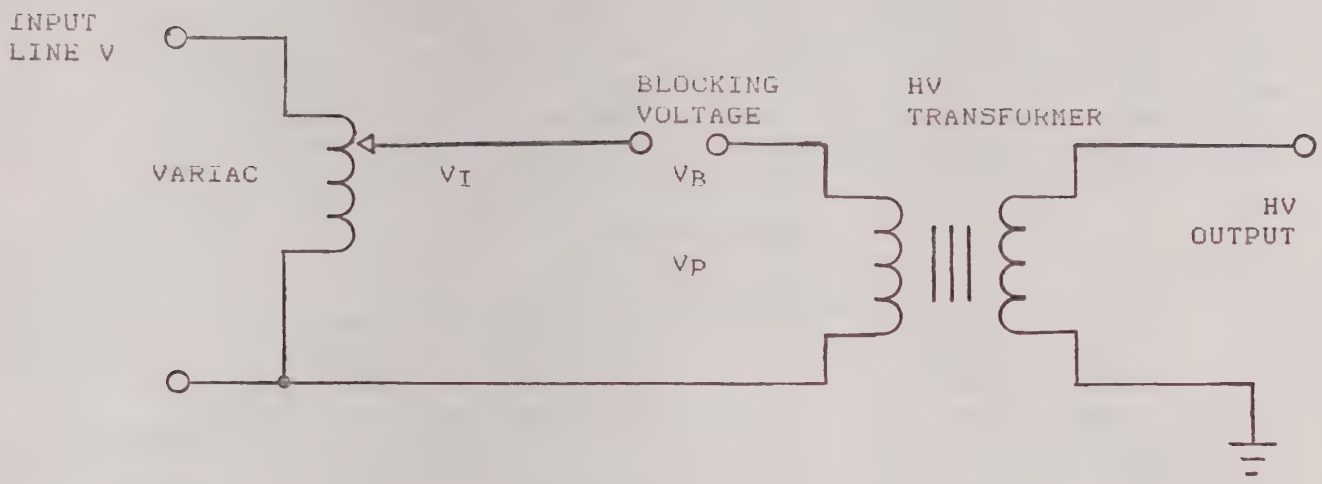


Figure 3-2: HV Amplitude Control

The HV output is directly proportional to Vp. Where Vp is the voltage V_I given by the variac minus the blocking voltage V_B generated across the HV AMPLITUDE CONTROL. When V_B equals or exceeds the voltage across V_I, Vp is zero as is the HV output. As V_B decreases, Vp begins to be different from zero, producing HV in the output of the HV transformer. This unique system has proved to be the most efficient solid state way to control the HV amplitude not only in terms of dissipating power, but in terms of invariance of blocking voltage V_B with respect to the nature of the load connected at the HV output, which makes HV amplitude practically independent of the load and sinusoidal through all the linear ramp-up to full voltage.

The RAMP UP CONTROL circuitry integrates the difference between the ramp up reference signal and the voltage feedback producing a controlling signal. This signal controls key parameters in the HV AMPLITUDE CONTROL, causing the HV output to follow the ramp up signal as shown in Figure 3-3.

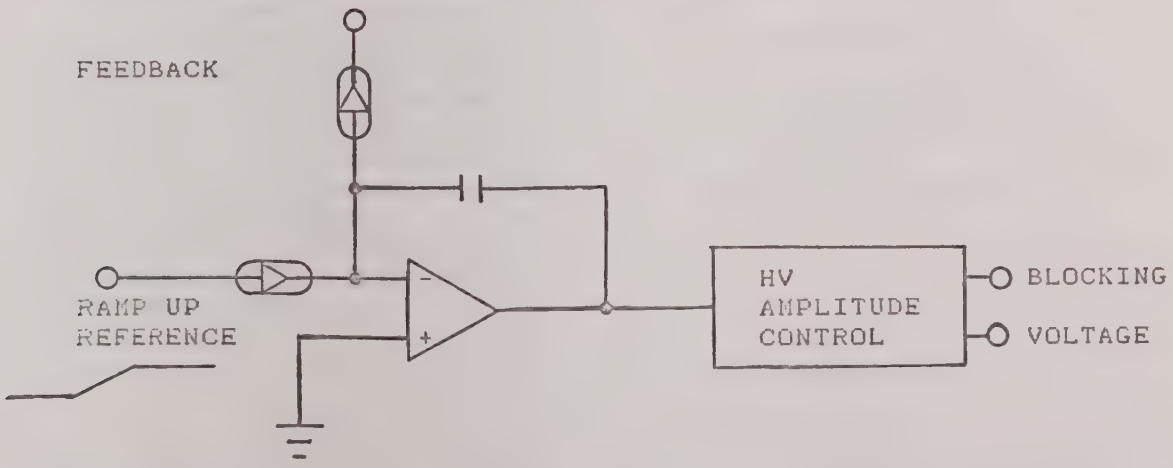


Figure 3-3: Ramp Up Control

The GENERAL CONTROL performs the coordination of the different activities and monitoring. As shown in Figure 3-4, the GENERAL CONTROL can be commanded from the different front and rear panel controls shown on the left side of the diagram. It coordinates the HV CONTROL activities and senses the status of the operation, providing continuous monitoring through the front panel lights, buzzer, and meter as shown on the right side of the diagram.

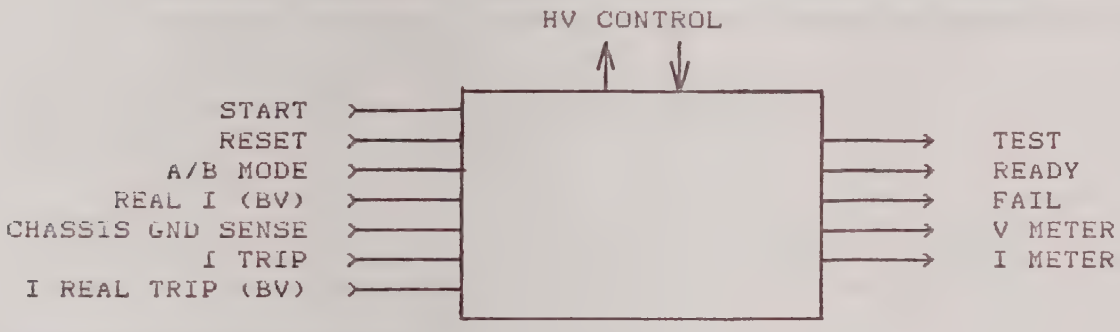


Figure 3-4: General Control

The REMOTE CONTROL option is an isolated interface for most of the control and monitor signals.

3-3.2 Instrument Assembly Diagram

The instrument is divided into two major subassemblies as shown in Figure 3-5. The right side contains the A6-S5 PC board and the electrical transformers needed for the operation. The left side contains the low voltage circuitry: the A11 and A21 PC boards, the A2-1 PC board for BV models, and option A8 PC board.

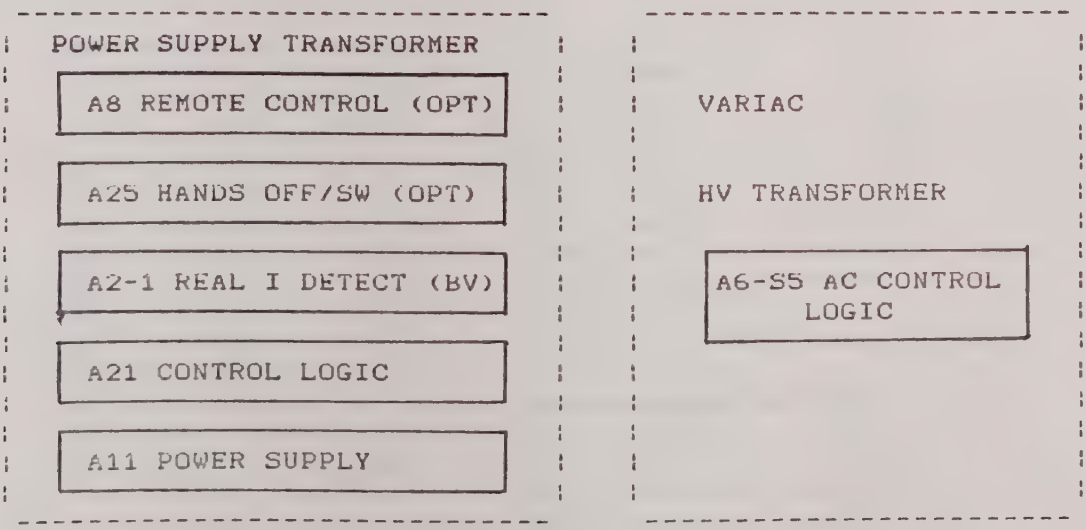


Figure 3-5: Assembly Diagram

A more detailed diagram of the Hipot's functions is shown in Figure 3-6.

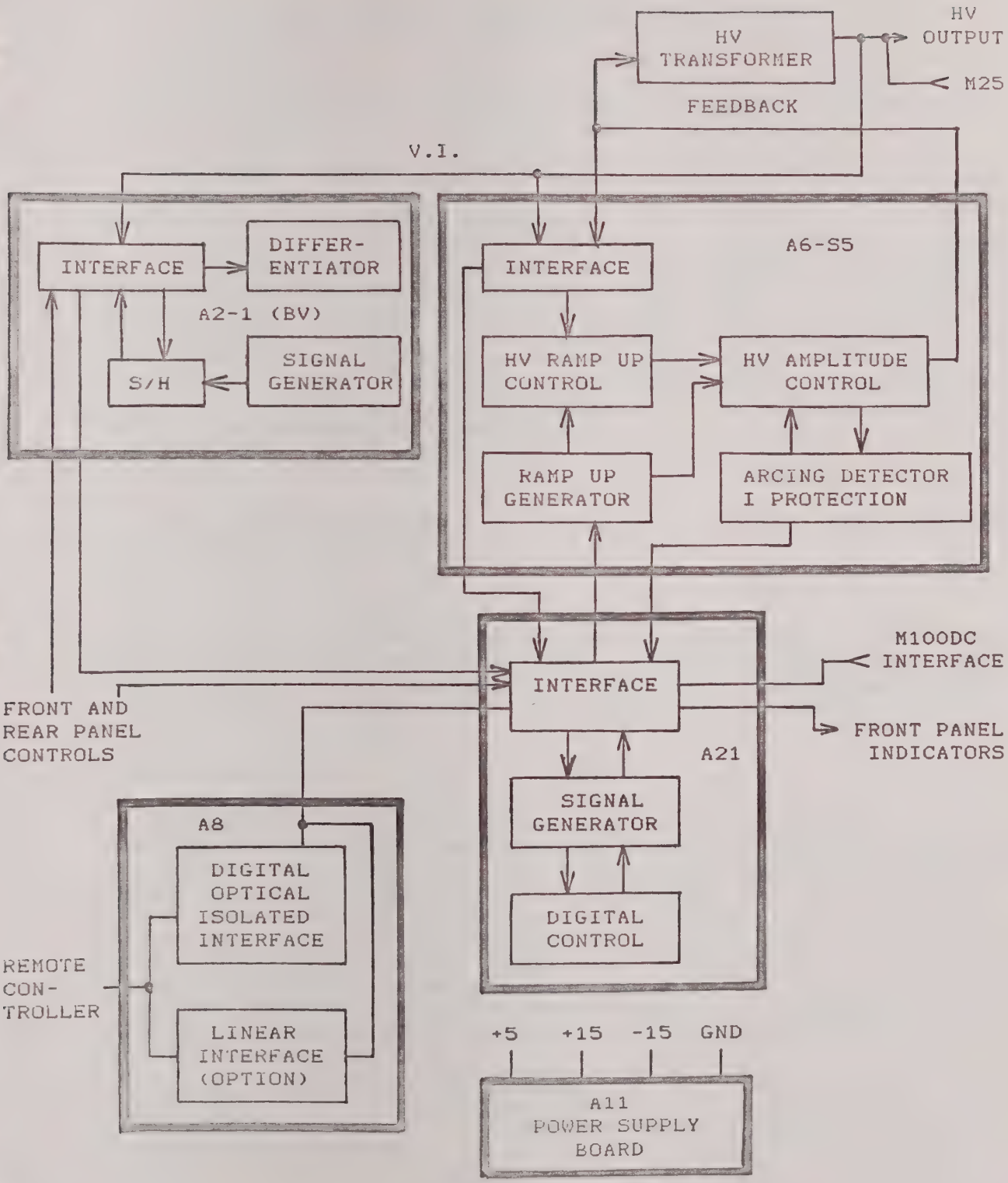


Figure 3-6: Detail Assembly Diagram

3-4. A11 P. C. Board: Power Supply/Undercurrent

3-4.1 Description

The A11 P. C. Board contains two circuits: the POWER SUPPLY and UNDERCURRENT.

The POWER SUPPLY section provides +15 VDC and -15 VDC regulated for the analog circuits. It also provides +5 VDC regulated for the digital circuits.

The UNDERCURRENT portion enables the detection of a minimum amount of current required during a hipot test. If there is not enough current flowing as determined by the undercurrent potentiometer setting, it is interpreted that the Device Under Test is not connected, and a FAIL signal of about one second is produced. The FAIL signal activates both the fail light and the alarm. At the end of the fail indication, the unit is completely RESET if no restart is attempted.

3-4.2 Theory

The A11 board contains two circuits: the POWER SUPPLY and the UNDERCURRENT detection.

POWER SUPPLY

18VAC is fed through pins 3 and 4 to the full wave bridge rectifier U5. C1 and C2 are the filtering capacitors. The regulator 7815, VR2, provides the +15V, while the regulator 7915, VR3, provides the -15V. 9VAC is rectified by U6 and regulated by the 7805, VR1, to +5.

UNDERCURRENT

The capacitor C10 is part of the U3 timing circuit and its charging up time determines the length of the pulse produced by U3. U3 is triggered when the TEST signal goes low, in other words, when the test begins and a high level is produced at the output (pin 3) of U3. That output will remain high until C10 charges up to 2/3 of the +5V supply. However, the comparator U4 has to sense the presence of current higher than the tripping point before C10 charges up. U4 must drive Q3 after a certain length of time and discharge C10. Otherwise the output of U3 will fail, triggering U2 which gives a pulse driving the FAIL and the RESET of the system.

The TRIP point value is fed through pin R of the board. The RETURN of the ammeter is on pin E, which is compared at U4 with the TRIP point value.

[illegible] UNDERCURRENT [illegible] SET Undercurrent Instructions

The UNDERCURRENT detect feature requires a minimum of three (3) seconds to react. That is, the tester will not sense for undercurrent until the high voltage has reached a certain voltage. To select the undercurrent fail point:

1. Set the UNDERCURRENT potentiometer to maximum counterclockwise position to begin.

2. Follow the procedure for setting total current fail point. Remember, FAIL will be indicated at all current levels below selected level.

3. Undercurrent failure is indicated by:

   A) Fail light comes on for one second

   B) Audible alarm is on for one second

   C) High voltage automatically shuts down

   D) Tester resets itself

4. Ground fault failure is indicated by:

   A) Fail light comes on for one second

   B) Audible alarm is on for one second

   C) High voltage automatically shuts down

   D) Ready lamp goes off

   E) Requires manual reset

5. High current (over current) failure is indicated by:

   A) Fail light continuously on

   B) Audible alarm continuously on

   C) High voltage automatically shuts down

   D) Requires manual reset

3-5. A5-S5 P. C. Board: High Voltage Control/Slow Rise Time

3-5.1 Description

The A6-S5 P. C. Board contains the HV CONTROL and SLOW RISE TIME or RAMP UP CONTROL. Supporting these sections are circuits for the RAMP UP GENERATOR, the VOLTAGE FEEDBACK, the output CURRENT and VOLTAGE monitoring, and the CURRENT PROTECTION and ARC DETECTION. Refer to Drawing 00632-01.

3-5.2 Theory

HV CONTROL

The HV CONTROL has been discussed in Section 3-3.1. The amount of blocking voltage V_B depends on the resistance of the photo resistor, PC1. Q1 and Q2 are used to drive the primary of the HV transformer. When the relay, K1, closes, the gate, Q3, is enabled, allowing the input line voltage to go through and set the circuitry in an initial condition prior to the driving of the HV transformer.

VOLTAGE FEEDBACK AND MONITORING

The voltage at the primary of the HV transformer is fed back through the optical isolators, U3 and U4, producing a full wave rectified current proportional to that voltage. The HV output is fed back through precision resistors, R3 and R6, to produce an average current through the voltmeter proportional to the RMS value. The resistor R12 is in series to provide a HV monitoring.

RAMP UP GENERATOR

When the TEST signal at TP2 gets low, the voltage at the input of CR1 becomes negative and no current flows through it, so only the current flowing through R29 and determined by one of the potentiometers, R4 or R30, goes through the capacitor, C2, charging it. Since the charging current is constant, the output of the op amp, U1 pin 6, is a linear RAMP UP.

RAMP UP CONTROL

The op amp, U2, compares the current produced through R10 and R11 with the full wave rectified current from U3 and U4, and integrates the difference. An amount of voltage appears at the primary of the HV transformer, such that a certain value of voltage different from the initial +5V is produced at pin 6 of U2, permitting an increase in the amount of current sunk by LED1. This value of current determines the resistance of PC1 to produce the amount of HV at equilibrium.

ARC DETECTION

The optical coupler, U5, senses for currents that are several times higher than the full scale value. This condition occurs during arcing, and as it does, a signal is sent to the A21 board.

3-6. A21 P. C. Board: Control Logic

3-6.1 Description

The A21 board (reference drawing 00462-01) receives the voltage across the current sense resistor, rectifies and filters it, and sends it to a comparator that triggers when preset limits of total current are exceeded. The board also has a ground loop circuit to detect safety ground violation.

3-6.2 Theory

ACTIVE RECTIFIER-FILTER

The op amp, U5, functions as a precision full wave rectifier of the AC voltage present on the current sense resistor during a test. U5 overcomes diode nonlinearities by placing the rectifying elements, CR2 and CR3, in the feedback path. Summing this signal with 1/2 the input signal provides a full wave rectified output. C6 filters the signal with op amp U4. The output is passed through the TOTAL CURRENT METER calibration potentiometer, R19, to the ammeter.

CURRENT COMPARATORS

Op amp U1 is used as a high gain amplifier with weak negative feedback, and acts as a comparator. R21 and R22 provide common mode protection. C7 provides extra filtering.

SAFETY GROUND DETECT CIRCUIT

The op amp, U8, plus R24, R25, CR4, and CR5, half wave rectifies the voltage between ground and the CHASSIS GROUND SENSE binding post. This voltage is 1.5 VAC if the CHASSIS GROUND SENSE binding post is OPEN. When the Device Under Test (DUT) completes the circuit through its ground wire to ground, the voltage at the binding post is proportional to the resistance of the ground wire in the DUT. R26, R27, and C20 determine the trip point for the Darlington pair, Q3 and Q4. The resistors are selected such that a 0.5 ohm loop resistance leaves the transistors OFF. Q3 then turns on the READY lamp and allows the START button to be pressed.

CONTROL LOGIC

This circuit receives all push button inputs and sense outputs from the fail comparators and the ground sense logic. When the proper conditions are satisfied, a test sequence is permitted. The duration of a test is set by a timing circuit. In the event of an operator reset or fail condition, the test is aborted. If there is a failure, a warning is presented until manually reset by the user. This circuit includes a zero crossing detector, a timer, and a set-reset latch with associated logic.

INPUT/OUTPUT LINES

There are three digital inputs: OVERLOAD, START, and RESET.

An OVERLOAD signal is produced whenever an arcing condition is detected by the A6-S5 board, (or a failure is produced by the A2-1 Real Current Board on BV models.) This signal combines with the overcurrent signal generated by the op amp, U1, and the ground failure signal generated by the op amp, U4 pin 3, to set the fail latch at pin 5 of U7. The ground fail is generated only when a faulty ground is detected during a test. This gating is produced by pin 2 of U7.

The START signal is produced by the start switch, which is tied externally to the ground test signal. If this is low, a START signal is produced at the NAND Gate, U3 pin 13. U3 pin 8 produces pulses synchronized with the AC line's zero crossings if no failure has been latched and if the machine is not in a test. The timer, U2, controls the total test time with R2, R3, R37, and C2. It can be reset by the FAIL latch.

The RESET signal resets the timer, U2, and the fail latch.

There are 3 outputs: GROUND TEST, TESTING, and ALARM, all of which also drive the corresponding lamps.

The GND TEST signal goes low whenever the CHASSIS GROUND SENSE loop does not exceed the resistance trip value.

The ALARM signal goes low whenever the fail latch is set.

The TESTING signal is delivered in parallel by Q1 and Q8, and they are low whenever the machine is in a test mode.

TIMER AND ENABLE CIRCUITS

To trigger a timing period at the timer, U2, a start pulse must occur and no failure can be present. The AC Hipot Tester also requires a zero crossing on the 60 Hz AC line. The NAND Gate, U3, detects this and passes it to U2, R2, R3, and R37, and C2 determines the test time. Parts of the hex inverter, U6, drive the RESET input of the timer if a test abort is required.

FAIL LATCH

Two NAND Gates on U7 are cross coupled to form the FAIL latch. The latch shows a ground fail condition only during a test cycle attempt gated by pin 2 of U7. Pins 9 and 10 of U7 sense for failures caused when arcing or overcurrent conditions are produced.

3-7. BV THEORY OF OPERATION

3-7.1 High Voltage Configuration

The high voltage configuration is essentially the one used in the standard AV Hipot Tester models as shown in the wiring diagram of the high voltage configuration. R1 is a set of high voltage resistors for limiting the current through the ammeter to 1 mA. RV is a factory selected resistor for producing a voltage of about 3 volts RMS for monitoring the high voltage output. RI is the current sense resistor and is also factory selected for producing about 5 volts RMS maximum for monitoring the leakage current. Assuming a pure resistive load, the current monitoring waveform is 180° out of phase with respect to the voltage monitoring waveform.

3-7.2 Determination Of The Resistive Load Or Real Component Of The Current

The high voltage waveform is mainly a sinusoidal one with a certain percentage of distortion. The AC input line voltage is a waveform already distorted by 5 to 6%. The primary effect is that the peak of the voltage waveform does not necessarily correspond with the 90° position and does not necessarily remain stable.

Since the real component of interest during the hipot testing is the one reflecting dissipation and not those of the harmonics of the 60 Hz pure sinusoidal, it is of primary importance to determine where exactly the peak of the voltage waveform occurs under any circumstance. The integration of the waveform is not practically advised because the undesirable offset effects and the low pass filtering version of the integration would provide only a predetermined amount of phase shift, which does not necessarily correspond to the location of the peak voltage waveform.

With a capacitive load the current waveform has to be zero. Any value different from zero reflects a resistive component that can be modeled as a resistive element in parallel with the ideal capacitance. This approach permits us to determine a dissipative current component which can tolerate a large amount of distortion in the voltage waveform. One big limitation of the circuitry, however, is the sensitivity of the differentiator to uncommon amounts of noise and distortion. Revision level C of the Real Current Detect Board has upgraded immunity to this with extra filtering and timing circuitry. This permits the sampling of the leakage current waveform only when the peak of the voltage waveform occurs around 90°, where, ideally, it should be.

The approach described above permits us to look at the dissipative component of the leakage current under conditions very far from the ideally linear ones, like distorted voltage and current waveforms and nonlinear capacitances. However, if distortion and nonlinearities become more severe, an approach to the problem has to be taken different from the linearizing one.

In this case the resistive component would lose its meaning. Another concept could be dissipating power, which we are prepared to take into development.

3-7.3 A2-1 P. C. Board: Real Current Detect Circuit

The A2-1 board (reference drawing 00442-01) receives at pin 5 the voltage generated across the voltage sense resistor on the A6-35 board. The first half of the op amp, U1, operates as a buffer. The first half of op amp U2 provides the derivative of the voltage signal which is proportional to the HV output, and the second half of U2 converts this signal to a square wave signal, which rises and falls at the peaks of the voltage signal. The NAND Gate, U8, produces a small pulse of approximately 10 µS width coincident with the negative peak of the voltage signal. The sample and hold, U4, provides the necessary filtering, along with C13, of the current waveform.

The second half of op amp U1 is a leading circuit which is adjusted to provide the exact triggering at the negative peak of the voltage signal to compensate for the circuit delays.

The output of the op amp, U3 pin 10, is the amplified value given by U4, the sample and hold. It is calibrated by R7 for giving RMS current values to the ammeter through R18. The second half of U3 is comparing the actual current with the real current trip point to identify overcurrent failures. Severe nonlinearities in a Device Under Test (DUT) can produce a false reading on the hipot ammeter. For avoiding this, the timer, U7, times the generation of the 10 µS pulse only for transitions of the waveform at U2 pin 12 occuring near the peak of the voltage waveform. U6 provides buffering for external trip programming. U5 is an analog switch for selecting remote trip output meter operation.

3-7.4 Real Current Detect Board, Recent Revisions

The former Revision level C of the REAL CURRENT DETECT BOARD is an upgraded version of the former REAL CURRENT DETECT BOARD where an extra immunity to noise and distortion is included as well as real current remote monitoring and trip point programming. The board is revised to revision level D for adapting it to the high voltage configuration described above.

3-7.5 Real Current Detect Board, Revision Level D

The voltage across the voltage monitoring resistor RV is connected to a differential amplifier, U1. Its output, at pin 12, is fed to the phase shifter so that the output at pin 10 of U1 is leading by a small amount for compensating for the different delays in the circuitry. The output is applied to the differentiator where we obtain the inverse of the derivative with the leading zero crossing being coincident with the positive peak of the voltage waveform. The output of the differentiator is applied to the squaring amplifier for obtaining a square waveform in phase with the derivative, but with the rising edge being

coincident with the negative peak of the high voltage monitoring waveform. This is because the leakage current we want to look at is 180° out of phase with respect to high voltage.

The voltage monitoring signal is fed to U6, a timing circuit, through pin 1 of RN3, which squares the waveform and produces the triggering of the monostable multivibrator, U7. This puts a single pulse out of pin 8 of the NAND Gate, U8, around the negative peak of the voltage monitoring signal. This pulse allows the zero crossing signal represented by the rising edge of the output of U2 pin 10 to go through U8 producing a signal pulse of about 7 µS from the output, U8 pin 4, coincident with the negative peak of the voltage monitoring signal. This pulse is used in the sample and hold, U4, to sample the leakage current waveform, which gets in through U4 pin 3 after being buffered by U6. Any positive value which is sampled is reflecting a dissipative current, and is fed to the noninverting amplifier for driving the ammeter. R7 adjusts the gain of this amplifier, U3. The other half of U3 is used to compare the tripping value with the actual current, giving a failure signal if this exceeds the former. The dissipative value given by U3 is also given externally for monitoring purposes.

U6 can also accept external trip point programming, which is selected through the remote board, activating the REMOTE signal through pin 6 of the board. The analog switch, U5, permits the driving of the ammeter while in a test situation. The component of the current in phase with the negative peak of the voltage monitoring signal reflects a dissipative current, i.e., is positive.

Section 4

MAINTENANCE AND SERVICE

4-1. Introduction

This section provides maintenance and service information for the ROD-L AC Hipot Testers. Included are tables of recommended test equipment, calibration procedures, troubleshooting procedures, plus repair and adjustment data.

4-2. Calibration

There are eight major points that need calibration on the ROD-L AC Hipot Testers. They are as follows:

1. Meter Mechanical Zero
2. TOTAL Ammeter calibration
3. TEST TIME calibration
4. REAL CURRENT Meter calibration (BV model only)
5. VOLT Meter calibration
6. FAIL Potentiometers calibration
7. SAFETY GROUND OHMS calibration
8. RAMP RATE calibration

Table 4-1: Recommended Equipment

TYPE	MANUFACTURER	USE
AC/DC Digital Ammeter Voltmeter (floating input)	Data Tech Model 31 or equivalent	General Purpose and Calibration of Voltmeter and Ammeter
AC Variac	General Radio W8MT3VM or equivalent	AC Line Voltage Set Up
120/240 VAC Line Step Up Transformer		220 and 240 VAC Tests
Oscilloscope	HP 175 or equivalent	General Purpose
High Voltage Probe	Simpson #0161 cal test or Ross Engineering #VMP-15-C.1	Voltage Measurements
Standard Resistor Box 0.6 ohm & 0.4 ohm 1%	General Radio 510-A or equivalent	Safety Ground Ohms Check
High Voltage Loads	See Table 4-2	Calibration of Ammeters

4-2.1 Meter Mechanical Zero

With the Hipot Tester turned OFF, note the positions of the voltage and ammeter pointers on the front panel. They should read zero ± one minor division. If they do not, adjust the zero screw.

4-2.2 A21 Logic Control Calibration

1. Equipment Set-Up:

The test equipment should be set up to ensure testing at 115 VAC ± 1% unless otherwise noted. Users may want to recalibrate on their standard voltages and frequencies. If line frequency is different from 60 Hz, remember that required capacitor values will change.

TOTAL CURRENT METER CALIBRATION

Turn the Hipot Tester on and note that the TOTAL CURRENT METER position is at zero ± one division. Connect the SAFETY GROUND SENSE wire to the chassis so that the READY lamp lights. The METER should still be zero. If not, troubleshoot the FULL WAVE TOTAL CURRENT DETECT circuit.

Insure that no load is placed in the HIGH VOLTAGE OUTPUT SOCKET. Push the START button.

WARNING

HIGH VOLTAGE NOW APPEARS ON THE HV OUTPUT BLOCK

Note the meter reading. It should be zero ± one division.

Push the RESET button. Insert a Digital Ammeter in series with a 0.95% of full scale high voltage load resistor (AV only) or a high voltage load capacitor (AV and BV) as shown in Figure 4-1.

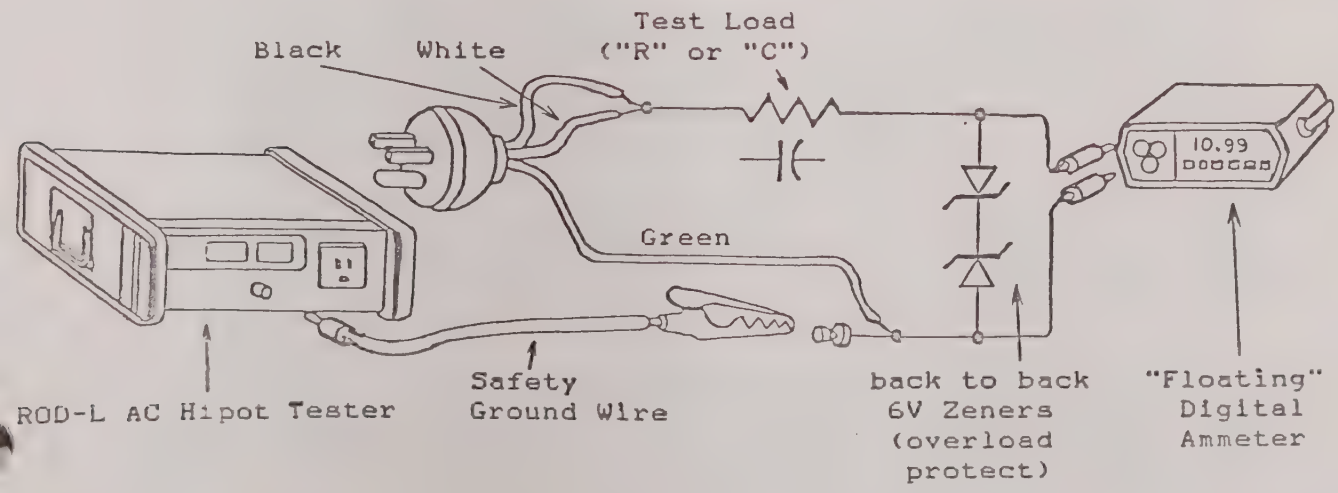


Figure 4-1: Setting Up With a Digital Ammeter

Table 4-2: Load Requirments for ROD-L AC Hipot Testers

ROD-L AC HIPOT TESTER	REQUIRED LOAD
M100AV 1.5kV - 10 mA	160k ohm 3% 3kV 20W resistor or 0.016 µF 2k VAC capacitor
M100AV 1.5kV - 50 mA	28k ohm 3% 3kV 100W resistor or 0.08 µF 2k VAC capacitor
M100BV 1.5kV - 10 mA	1.15M ohm 3% 3kV 3W noninductive resistor and 0.016 µF 2k VAC capacitor
M100BV 1.5kV - 50 mA	300k ohm 3% 3kV noninductive resistor or 0.08 µF 2k VAC capacitor
Other M100AV and M500AV Units	Calculate resistor value from this formula: $R = \frac{\text{Hipot Voltage}}{0.95 \times \text{Full Scale Current}}$ $C = \frac{0.95 \times \text{F.S. Total Current}}{2\pi f \times \text{Hipot Voltage}}$
All BV Models	Calculate resistor value from this formula: $R = \frac{\text{Hipot Voltage}}{0.095 \times \text{F.S. "÷ 10 Real" Current}}$

WARNING

The ammeter must be inserted on low voltage side of the resistor or capacitor. Otherwise the ammeter's breakdown voltage to ground may be exceeded. The resistor and capacitor should be tested first to insure that they can withstand the rated voltage.

Set the ammeter to 100 mA Full Scale. Push the START button. The ammeter's current reading should agree with the reading on the TOTAL CURRENT meter allowing for 3% tolerance. For example, for a 10 mA F.S. meter the two readings should be within 0.30 mA of each other.

If they do not agree, adjust the TOTAL CURRENT AMMETER CAL potentiometer, R19, on the A21 P.C. board until the TOTAL CURRENT meter reading agrees with the digital ammeter reading with 1% tolerance. See Drawing 00462-01 for potentiometer positions.

2. Test Time Calibration:

Set a specific test time by following the instructions outlined in Section 2-13. To check the test time limits, turn the TEST TIME potentiometer on the A21 P.C. board to minimum and then maximum. Minimum should be a test one second long, and maximum greater than ninety seconds long. If not, troubleshoot the timer or call ROD-L for assistance.

4-2.3 A2-1 Calibration

1. Offset Adjustment:

A) Take the A21 P.C. board out.

B) Short pins 5 and 13 of the A2-1 Real Current P.C. board to Ground.

C) Turn R1 to get OV DC at TP2.

D) Now short pins 5 and 13 of the A2-1 Real Current board to +5V.

E) Turn R37 to get OV DC at TP2.

F) Turn R3 fully counterclockwise. Remove +5V from pin 5 and 13 and connect it back to ground.

G) Adjust R2 to read OV DC at TP3.

H) Adjust R6 to read OV DC at TP12 (20mV scale.)

I) Adjust R4 to read OV DC at TP4 (20mV scale.)

J) Adjust R5 and notice the level change from about OV to 15V at TP11. Leave R5 exactly where level change occurs.

K) Turn R7 fully clockwise.

L) Short TP8 to ground (U4 pin 3.)

M) Adjust R29 to read OV at TP9.

N) Adjust R8 to read OV DC at TP7 (20mV scale.)

O) Short TP5 and TP6 together.

P) Adjust R9 to produce a level change from 15V to about -15V at TP10 (5V scale.) Leave R9 exactly where the level change occurs.

Q) Replace the A21 P.C. board.

NOTE: Be sure to check zero every time the reference scale is changed on the oscilloscope and throughout the procedure. After a 20mV scale is used, a 5mV scale is advised.

2. Trigger and Meter Calibration:

A) Turn R7 three times counterclockwise.

B) Connect a resistor with a value equal to $\frac{\text{High Voltage x 10}}{\text{Full Scale Current}}$ or 200k ohm 3% 5kV when no other is available to output with an external ammeter in series with the low side of the high voltage.

C) Push the START button to generate HV. Push the ÷ 10 REAL button and turn R3 slowly clockwise until the CURRENT meter deflects in the positive direction. The CURRENT meter will ascend rather rapidly when at the low end of the scale. The reading on the CURRENT meter must be equal to full scale when the ÷ 10 REAL button is pushed. If necessary, slowly turn up the variac to get current.

D) Adjust R7 to read the same current on the front panel CURRENT meter as on the external ammeter.

E) Push the RESET button.

F) Connect a capacitor (typically 0.016 μF 5KV) in parallel to the resistor. Push the START button and check that the reading on the ammeter is about the same as before. If not, adjust R3 slowly to get a reading about 3% above the reading when the resistor was alone.

G) Take the resistor out and push the START button. Check the REAL CURRENT reading after the ramp up. This value added to the one when the resistor was alone gives the real current value when both capacitor and resistor are in place. If it does not, repeat step D.

4-2.4 Voltmeter Calibration

1. Disconnect all loads from the Hipot Tester. Connect a high voltage probe to a DVM. The HV probe is connected as a 1000 to 1 voltage divider by shunting the output with a 50k ohm resistor. Trim the value to compensate for DVM input impedance so that the system accuracy can be 1% or better. Connect the Ground lead of the HV probe and the SAFETY GROUND wire from the Hipot Tester to the Hipot Tester frame.

2. Push the START button.

WARNING
HIGH VOLTAGES APPEAR ON THE HV OUTPUT BLOCK

3. The voltmeter should rise slowly from zero after an initial delay. Note the voltage reading. Insert the HV probe into the HV OUTPUT SOCKET and read the voltage from the DVM. The two should agree within ± 3% of full scale. If they do not, change the value of R6 on the A6-S5 board until they do.

4-2.5 Fail Potentiometers Calibration

1. Turn all FAILURE SETPOINT potentiometers fully clockwise. Insert the calibration load listed in Table 4-2 to pull nearly Full Scale Current into the Hipot Tester HV OUTPUT SOCKET. The digital ammeter shown in Figure 4-1 is not needed in this test. However, the dual banana jacks should be shorted together.

2. Push the START button.

WARNING

HIGH VOLTAGES APPEAR ON THE TEST LOAD

3. While the high voltage is on, slowly turn the TOTAL CURRENT FAILURE SETPOINT potentiometer counter-clockwise until the FAIL lamp comes on.

4. Push RESET.

5. Note the position of the slot on the potentiometer. It should be near 10 on the dial scale. If it is less than 8, troubleshoot the A21 board or call ROD-L for assistance.

6. To check the REAL CURRENT FAILURE SETPOINT potentiometer, the resistor load used in Section 4-2.3 #2 is required (BV only.) The Digital Ammeter is not necessary for this test. If it is deleted, short the dual banana plug. Reset all SETPOINT potentiometers fully clockwise. Set up the load and plug into the Hipot Tester.

7. Push START button.

WARNING

HIGH VOLTAGES APPEAR ON THE TEST LOAD

8. While the high voltage is on, slowly turn the REAL CURRENT FAILURE SETPOINT potentiometer counter-clockwise until the FAIL lamp comes on.

9. Push RESET.

10. Note the position of the slot on the potentiometer. If it is less than 6, troubleshoot the A21 board or call ROD-L for assistance.

11. Repeat the test but turn the TOTAL CURRENT FAILURE SETPOINT potentiometer until the FAIL lamp comes on. It should be near 1 on the dial scale. AV users may also want to do this by constructing the appropriate load.

4-2.6 Safety Ground Ohms Calibration

1. Disconnect all loads from the Hipot Tester. Connect a 0.5 ohm resistor between the CHASSIS GROUND SENSE terminal on the front panel and the handle of the Hipot Tester. Make sure that the contact resistance of the Safety Ground wire is negligible.

2. Turn on the Hipot Tester. The READY lamp should come on.

3. Push the START button.

WARNING

HIGH VOLTAGES APPEAR ON THE HV OUTPUT BLOCK

4. The high voltage should come up normally and no FAIL condition should occur.

5. Push the RESET button.

6. Replace the 0.5 ohm resistor with a 0.6 ohm resistor. Insert this test circuit into the HV OUTPUT BLOCK and connect the GROUND SENSE as above. The READY lamp should NOT come on. Push RESET if necessary. The limits on the SAFETY GROUND TEST circuit have been verified. If the limits are not correct, troubleshoot the SAFETY GROUND DETECT circuit or call ROD-L for assistance.

WARNING

HIGH VOLTAGES APPEAR ON THE TEST CIRCUIT

7. Finally, disconnect the load to the Hipot Tester. Connect the GROUND SENSE wire to the frame of the Hipot Tester. The READY lamp should come on.

8. Push the START button.

9. While the high voltage is on, disconnect the GROUND SENSE wire. There should be a FAIL indication (lamp and alarm) immediately, and the high voltage should drop to zero.

10. Push RESET. The READY lamp should Not light until the GROUND SENSE wire is again connected to the Hipot Tester.

4-2.7 Ramp Rate Calibration

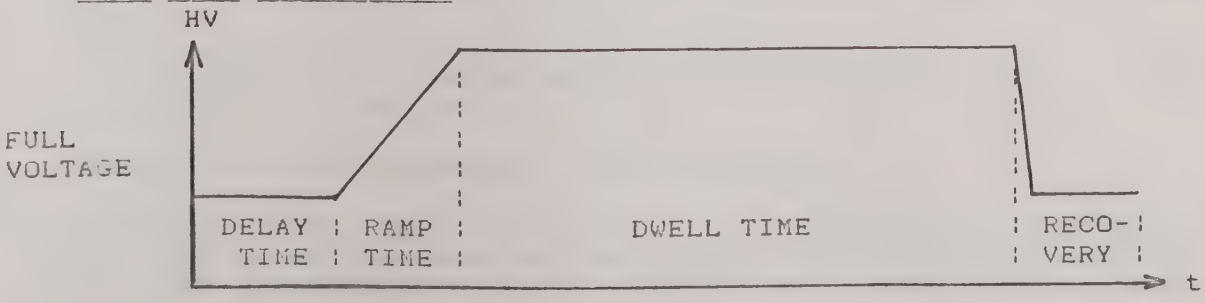


Figure 4-2: Test Cycle Parameter

Figure 4-2 shows the relation between the different parameters of control. The DELAY TIME is the time between pushing the START button and the beginning of the rising voltage. It should be between 0.5 and 1.5 seconds. Thus:

DELAY = 0.5 + K (RAMP RATE ÷ Full Scale Voltage Per Second)

The RAMP RATE is a controllable parameter adjusted by R30 and R4 for MODE A and B respectively. For each instrument, the RAMP RATE varies from about FULL SCALE VOLTAGE in one second to FULL SCALE VOLTAGE in 30 seconds. For example, for a 5kV unit the RAMP RATE is adjustable from 5000 V/second to 166 V/second. "K" is an instrument constant and varies from about 30 mS to 50 mS, so the expected DELAY TIME is from about 0.54 to 1.54 seconds.

The RAMP TIME is the time between the minimum point and the 100% point of the rising voltage, and is dependent on the RAMP RATE adjustment and the FULL VOLTAGE selected.

$$\text{RAMP TIME} = \frac{\text{FULL VOLTAGE}}{\text{RAMP RATE}}$$

If the same RAMP TIME is to be maintained when the FULL VOLTAGE is changed with the VARIAC control, the RAMP RATE has to be readjusted.

TEST TIME is the total DELAY, plus RAMP, plus DWELL TIME. The recovery time is about 0.5 second. So, for a 5kV unit with 5000V/sec RAMP RATE, 5kV full voltage, and 1 second dwell time, the TEST TIME selected has to be 0.54 second + 1 second + 1 second + 2.54 seconds, and the total TEST cycle time is 2.54 + 0.5 second (recovery time) = 3.04 seconds.

Proper operation of the RAMP UP CONTROL on the A6-S5 board should be verified by watching the OUTPUT VOLTAGE METER. No spurious oscillations should be seen on the output voltage waveform. At the end of the turn-on period, the voltage waveform should be sinusoidal except for very small amounts of crossover distortion (assuming a low distortion AC power line.)

Under full load conditions (use test load from Table 4-2,) the output voltage should vary less than 8% for capacitive loads. The waveform should still look essentially sinusoidal, with, in fact, less distortion than the one received at the input line. If not, troubleshoot the A6-S5 P.C. board or call ROD-L for assistance.

For initial calibration of the A6-S5 without running a TEST cycle, adjust the following:

1. Adjust R9 to read approximately -100 mV at TP3.

2. Select MODE A on the front panel and adjust the TEST TIME for approximately thirty seconds (or according to the desired RAMP TIME) with potentiometer A on the A21 P.C. board while running the test.

3. Then adjust R30 for the desired RAMP RATE. Clockwise decreases the RAMP RATE.

4. Select MODE B on the front panel and adjust the TEST TIME for approximately thirty seconds (or according to the desired RAMP TIME) with potentiometer B on the A21 P.C. board while running the test.

5. Then adjust R4 for the desired RAMP RATE. Clockwise decreases the RAMP RATE.

6. R20 is factory adjusted for waveform symmetry.

7. Readjust the TEST TIME if necessary.

4-3. Troubleshooting

4-3.1 The equipment required is listed in Teble 4-1.

4-3.2 Troubleshooting Tree Problem List

1. No AC Power

   A) Check fuses F1 and F2.

   B) Check for bad AC power lamp, I1.

   C) Check for bad ON-OFF switch, S1.

   D) Check for bad Line filter, 1.1-L2.

   E) Measure for line voltage on the A6-S5 P.C. board, TP6 and TP7 with the high voltage off.

2. Instrument Blows Fuses

   A) If only F1 is blowing:
   Check for shorted M10V1 or MOV2.
   Check for shorted T1.
   Troubleshoot A11 P.C. board.

   B) If only F2 or F3 is blowing:
   Check for shorted output power transistors.
   Check for internal short on T2.

3. High Voltage Meter Does Not Ramp Up Slowly

   A) Check for shorted output transistors.

   B) Check for leaky Q2 on the A6-S5 P.C. board.

4. Ready Lamp Does Not Work

A) Check for burned out bulb.

B) Check for bad connection at BP1 or bad 1 ohm 3W resistor on A6-S5 P.C. board.

C) Troubleshoot SAFETY GROUND OHMS DETECT circuit on the A21 P.C. board.

5. No High Voltage

A) Check for bad fuses F1 and F2.

B) Check for bad START switch.

C) Check wiring harness for frayed wiring.

D) Troubleshoot the A6-S5 P.C. board digital logic.

6. Failure Indicators Do Not Work or Work Erratically

A) Check to see if the leakage current meter works.

B) Check signals given by U5 on the A6-S5 P.C. board.

C) Determine which of three possible failures modes is being detected:
SAFETY GROUND FAULT
TOTAL CURRENT 9OVERLOAD
OVERLOAD: T2 Primary current greater than 1.2 Amp
Troubleshoot appropriate functional block.

D) Check initial condition voltage at the base of Q1 on the A6-S5 P.C. board.

7. Excessive Power Dissipation on the A6-S5 P.C. Board

A) Check for shorts, low beta, etc.

B) Check for internal shorts, corona, etc.

C) Measure the voltage on the A6-S5 P.C. board, TP6 and TP7 with the high voltage off. This voltage should equal line voltage. With high voltage on, this voltage should be less than 5 VAC RMS fully loaded after the RAMP UP.

8. Arcing Shutdown Does Not Work

A) Connect oscilloscope to the A21 P.C. board, pin 7, which is the optoisolator output. Short the Hipot Tester output. Adjust the oscilloscope trigger for a single sweep as optoisolator switches from +5V to 0V and back.

B) Push START. The FAIL lamp should go on after an approximate delay of one second when the HV comes up. The oscilloscope should show a 0.2 to 1 mS negative pulse from the optoisolator, thus verifying operation.

C) If no pulse appears or the pulse does not fall below 1 volt, repair optoisolator or associated circuitry.

D) If pulse appears, check with ROD-L for increased sensitivity for low level energy arcing.

Section 5

PARTS LISTS

ASSEMBLY DESCRIPTION: A11 UNDERCURRENT POWER SUPPLY W/O HANDS-OFF P. C. BOAR
SSEMBLY NUMBER: 00294-01 REV. A

P/N	DESCRIPTION	REFERENCE	QTY
00267-01	SCHEMATIC	REFERENCE	
00278-03	PCB, RAW	A11	1
00487-06	HEATSINK	HS1	1
0323-02	CAPACITOR, DISC .01µF 100V	C4,8,9,11,12	5
0060-01	CAPACITOR, TANTALUM 1µF 35V	C5,6	2
0013-01	CAPACITOR, TANTALUM 4.7µF 20V	C10,13	2
0324-08	CAP., ELECTROLYTIC 500µF 50V	C1,2	2
0324-04	CAP., ELECTROLYTIC 3000µF 16V	C3	1
0125-15	RESISTOR, CC 470 OHM ¼W 5%	R29	1
0125-31	RESISTOR, CC 1k OHM ¼W 5%	R18	1
0125-36	RESISTOR, CC 2.2k OHM ¼W 5%	R8,26	2
0125-40	RESISTOR, CC 4.7k OHM ¼W 5%	R12	1
0125-44	RESISTOR, CC 10k OHM ¼W 5%	R5,9-11,14,17	6
0125-79	RESISTOR, CC 20k OHM ¼W 5%	R15	1
0125-59	RESISTOR, CC 100k OHM ¼W 5%	R16	1
0125-69	RESISTOR, CC 330k OHM ¼W 5%	R30	1
0702-06	POTENTIOMETER, 5k 20 TURN 3006P-1-502 BOURNS	R19	1
0708-01	POTENTIOMETER, 500k 20 TURN 3006P-1-504 BOURNS	R13	1
0036-01	DIODE, SIGNAL 1N914	CR12-14	3
0032-01	DIODE, 100V 1A RCTFIR 1N4002	CR9-11	3
0030-01	DIODE BRIDGE, 70V 1A CSB05 COLLMER	U5,6	2
267-01	TRANSISTOR, NPN SSMTL 2N2222	Q5	1
0272-01	TRANSISTOR, NPN RF 2N3904	Q3,4	2
0659-01	INSULATOR THERMAL XISTOR TO-220 3223-07FR-54	VR1-3	3
0130-01	IC, REGULATOR, +5V 1A 7805 (OR LM340T5)	VR1	1
0169-01	IC, REGULATOR, +15V 1A 7815 (OR LM340T15)	VR2	1
0123-01	IC, REGULATOR, -15V 1A 7915 (OR LM320T-15)	VR3	1
0102-01	IC, OP AMP UA741	U4	1
0091-01	IC, TIMER NE555	U2,3	2
0264-08	SOCKET, IC 8 PIN LOPROFILE CDH-4000-08-B SAE	U2-4	3
	FUSE, 4A 125V 275004 LITTLEFUSE	F1	1
	WASHER, SHOULDAR 3102 KEYSTONE	VR1-3	3
0544-01	NUT, KEP 4-40	VR1-3	3
0530-03	SCREW, PHLP PAN SEM 4-40 X 3/8	VR1-3	3

-4,6,7, CR1-8, Q1,2 NOT USED ON DRAWING
',14-17, R15,20-25,27,28, Q6,7, U1 NOT USED W/O HANDS-OFF

ASSEMBLY DESCRIPTION: A21 AV/BV (WITH A11) CONTROL LOGIC P. C. BOARD
ASSEMBLY NUMBER: 00462-02 REV. G

P/N	DESCRIPTION	REFERENCE	QTY
00462-03	PCB, RAW	A21	1
50323-02	CAPACITOR, DISC .01µF 100V	C1,3,4,7[2],8[2],9[2],10 11-13,15	
50066-07	CAPACITOR, MONOLYTHIC .47µF 50V	C14	1
50060-10	CAPACITOR, TANTALUM 4.7µF 35V	C6[2]	1
50060-14	CAPACITOR, TANTALUM 10µF 15V	C5	1
50060-04	CAPACITOR, TANTALUM 22µF 15V	C10	1
50324-02	CAP., ELECTROLYTIC 150µF 16V	C2	1
50125-31	RESISTOR, CC 1k OHM ¼W 5%	R10,11,33,34,40	5
	RESISTOR, CC 2.5k OHM ¼W 5%	R29[1]	1
50125-39	RESISTOR, CC 3.3k OHM ¼W 5%	R20[2]	1
50125-40	RESISTOR, CC 4.7k OHM ¼W 5%	R1,4-9,30[2],44	9
50125-43	RESISTOR, CC 6.8k OHM ¼W 5%	R3	1
50125-84	RESISTOR, CC 7.5k OHM ¼W 5%	R18[12]	1
50125-85	RESISTOR, CC 8.2k OHM ¼W 5%	R43	1
50125-44	RESISTOR, CC 10k OHM ¼W 5%	R22[2],23[2],24,28, 35	5
50125-47	RESISTOR, CC 18k OHM ¼W 5%	R26	1
50125-79	RESISTOR, CC 20k OHM ¼W 5%	[2]R12-16	5
50125-54	RESISTOR, CC 51k OHM ¼W 5%	R17[1]	1
50125-55	RESISTOR, CC 56k OHM ¼W 5%	R38	1
50125-56	RESISTOR, CC 68k OHM ¼W 5%	R25,36,41	3
50125-59	RESISTOR, CC 100k OHM ¼W 5%	R27,39	2
50025-61	RESISTOR, CC 10m OHM ¼W 5%	R21[2]	1
	RESISTOR (SELECTABLE)	R31,32	2
	POTENTIOMETER, 2k 20 TURN 3006P-1-202 BOURNS	R19[2]	1
50708-01	POTENTIOMETER, 500k 20 TURN 3006P-1-504 BOURNS	R2,37	2
50036-01	DIODE, SIGNAL 1N914B	CR2[2],3[2],4,5,8,9	6
50044-01	DIODE, 4.7V ZENER 1N750	CR6[2]	1
50267-01	TRANSISTOR, NPN SSMTL 2N2222	Q1-3[2],7-9	6
50269-01	TRANSISTOR, PNP SSMTL 2N2907	Q6	1
50272-01	TRANSISTOR, NPN RF 2N3904	Q4,5	2
50102-01	IC, OP AMP UA741	U1[2],4[2],5[2],8	4
50091-01	IC, TIMER NE555	U2	1
50135-01	IC, QUAD 2IN NAND SN7400	U7	1
50138-01	IC, HEX INVERTER, OC SN7405	U6	1
50142-01	IC, DUAL 4IN NAND SN7420	U3	1
50264-08	SOCKET, IC 8 PIN LOPROFILE CDH-4000-08-B SAE	U1[2],2,4[2],5[2],8	5
50264-14	SOCKET, IC 14 PIN LOPROFILE CDH-4000-14-B SAE	U3,6,7	3
50151-01	PIN, TEST 1405-3 KEYSTONE	TP1-3,4[2],5[2],6,7	7

R42, CR1,7 NOT USED ON DRAWING

1 FOR USE WITH A10:

50125-39	RESISTOR, CC 3.3k OHM ¼W 5%	R18	1
50125-44	RESISTOR, CC 10k OHM ¼W 5%	R29	1
50125-79	RESISTOR, CC 20k OHM ¼W 5%	R17	1

2 DELETED FOR OHM SENSE TESTER UNIT

ASSEMBLY DESCRIPTION: A6-S5 M100AV/BV AC SLOW RISE CONTROL P. C. BOARD
ASSEMBLY NUMBER: 00238-02 REV. C

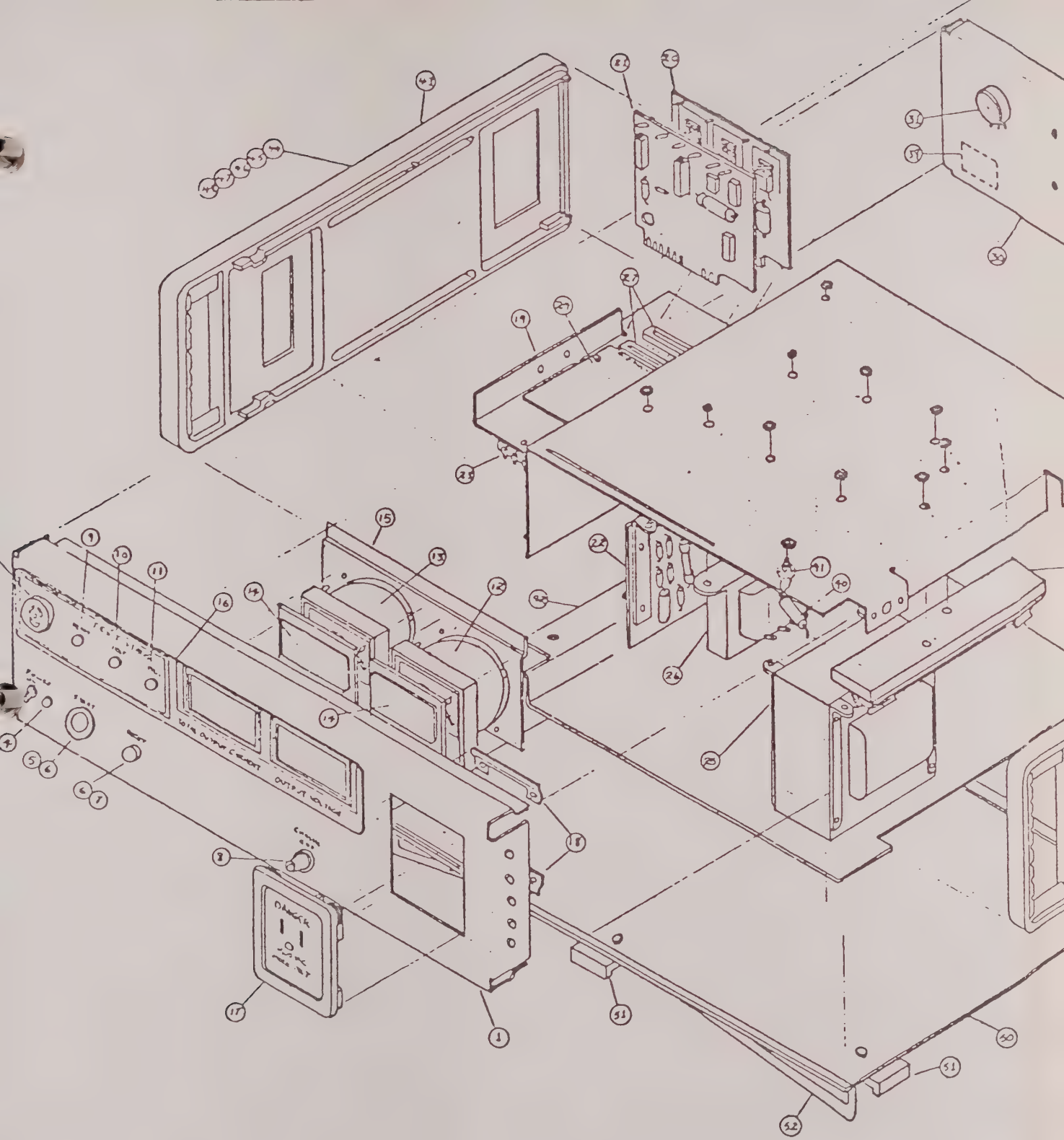
P/N	DESCRIPTION	REFERENCE	QTY
00632-01	SCHEMATIC	REFERENCE	
00153-09	ASSY, PEC-LED HOUSING	LED1	1
00665-05	HEATSINK	HS1	1
00212-03	PCB, RAW	A6S5	1
50323-02	CAPACITOR, DISC .01µF 100V	C8 (BACK)	1
50209-03	CAPACITOR, DISC .01µF 1KV	C7	1
50324-05	CAP., ELECTROLYTIC 10µF 25V	C1	1
50060-06	CAPACITOR, TANTALUM 22µF 35V	C3	1
50060-08	CAPACITOR, TANTALUM 33µF 10V	C6	1
50060-15	CAPACITOR, TANTALUM 220µF 6V	C2	1
50309-02	RESISTOR, WW .33 OHM 2W 1% RS2B	R24[1],27[1]	2
50316-01	RESISTOR, WW 1 OHM 3W 1%	R13	1
50150-06	RESISTOR, CC 68 OHM 1/2W 5%	R14[3],21	2
50150-07	RESISTOR, CC 100 OHM 1/2W 5%	R16,22,28	3
50150-30	RESISTOR, CC 1k OHM 1/2W 5%	R23	1
50325-55	RESISTOR, MF 1.21k OHM %W 1%	R5	1
50525-32	RESISTOR, MF 1.62k OHM %W 1%	R1	1
50125-35	RESISTOR, CC 2k OHM %W 5%	R7[3]	1
50525-33	RESISTOR, MF 3.48k OHM %W 1%	R10[3]	1
50150-33	RESISTOR, CC 3.6k 1/2W 5%	R15	1
50325-36	RESISTOR, MF 4.64k OHM %W 1%	R8	1
50150-34	RESISTOR, CC 7.5k OHM 1/2W 5%	R17	1
50325-41	RESISTOR, MF 15k OHM %W 1%	R2	1
50125-79	RESISTOR, CC 20k OHM %W 5%	R29	1
50200-43	RESISTOR, CC 82k OHM 1W 5%	R25	1
50200-44	RESISTOR, CC 100k OHM 1W 5%	R26	1
50150-52	RESISTOR, CC 330k OHM 1/2W 5%	R6,18,19	3
50316-11	RESISTOR, HV OXIDE 1.2meg OHM	R3[3]	1
	RESISTOR (SELECTABLE) %W 5%	R11[3]	1
	RESISTOR (SELECTABLE) 3W 1%	R12[3]	1
50702-08	POTENTIOMETER, 20k 20 TURN 3006P-1-203 BOURNS	R9	1
50703-01	POTENTIOMETER, 25k 1 TURN 3386H-1-253 BOURNS	R20	1
50702-12	POTENTIOMETER, 1m 20 TURN 3006P-1-105 BOURNS	R4,30	2
50036-01	DIODE, SIGNAL 1N914B	CR1-8,11-13	11
50034-01	DIODE, 600V 1A RCTFIR 1N4005	CR14[1]-17[1]	4
50041-01	DIODE, 15V ZENER 1N5245B	CR9[2],10[2]	2
50270-01	TRANSISTOR, POWER 2N3439	Q1	1
50277-01	TRANSISTOR, SSMETAL 2N5416	Q2	1
50284-01	TRIAC T2700D	Q3	1
50175-01	INSULATOR, TRANSISTOR 4006 FOR TO-66	Q3	1
50102-01	IC, OP AMP UA741TC	U1,2	2
50089-01	IC, OPTICAL COUPLER MCT2E	U3-5	3
50264-06	SOCKET, IC 6 PIN LOPROFILE CDH-4000-06-B SAE	U3,4	2
50264-08	SOCKET, IC 8 PIN LOPROFILE CDH-4000-08-B SAE	U1,2	2

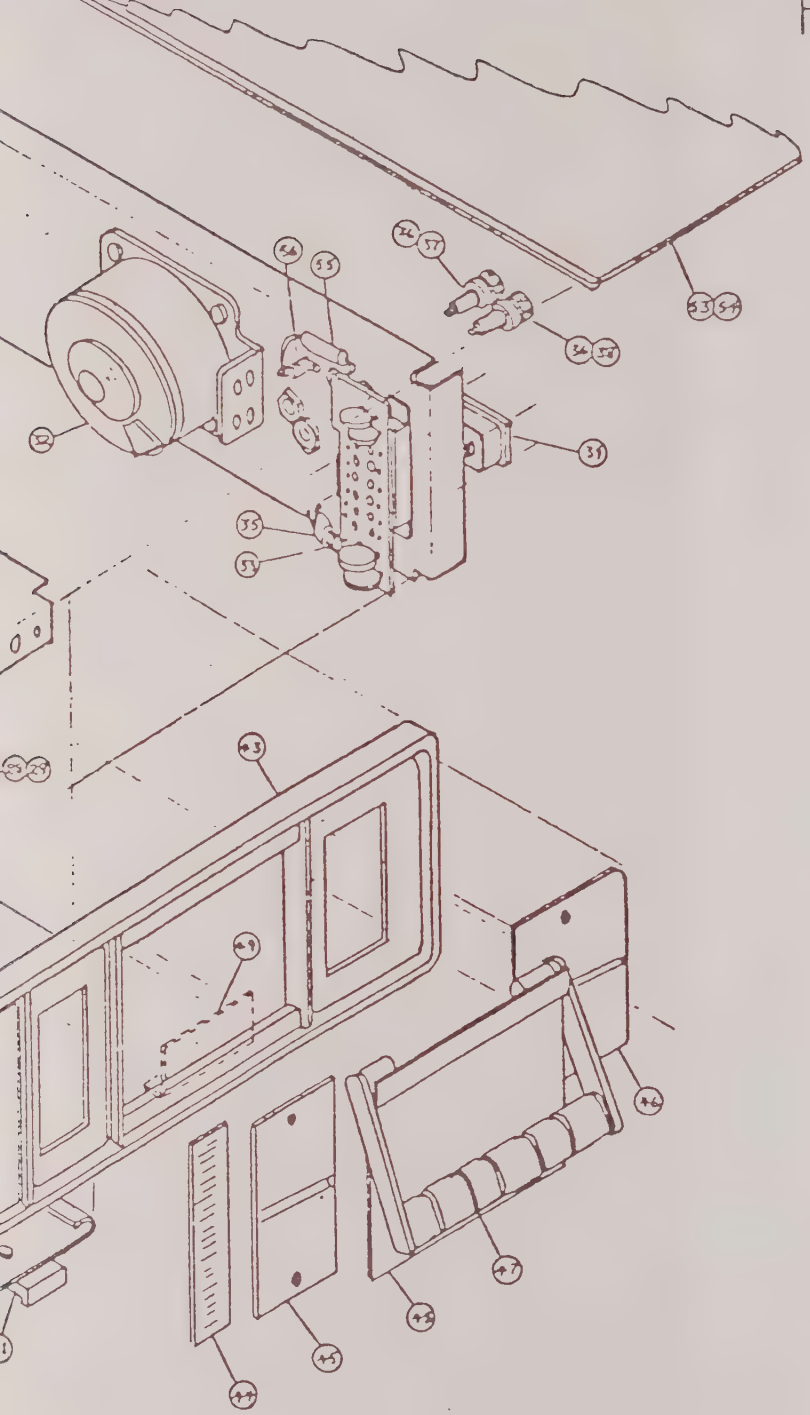
ASSEMBLY DESCRIPTION: A6-S5 M100AV/BV AC SLOW RISE CONTROL P. C. BOARD
ASSEMBLY NUMBER: 00238-02 REV. C

P/N	DESCRIPTION	REFERENCE	QTY
50151-01	PIN, TEST 1405-3 KEYSTONE	TP1-7	7
50332-01	RELAY, REED F81-5053A GORDOS	K1	1
50254-01	PHOTO ELECTRIC CELL NSL-446	PC1	1
50584-01	WASHER, FIBERGLASS #6 HHSMITH 2162	Q3	2
	WASHER, SHOULDER #6	Q3	2
50543-02	NUT, HEX 6-32	Q3	2
50531-04	SCREW, PHLP PAN SEM 6-32 X 1/2	Q3	2
50531-02	SCREW, PHLP PAN SEM 6-32 X 1/4	LED1	2
00109-52	LABEL, DANGER HV	HS1	1
C4,5 NOT USED IN DRAWING			
1 ON 500AV & 500BV UNITS:			
	RESISTOR, MF 1.65 OHM 2W 1%	R24,27	2
50035-01	DIODE, 400V 6A RCTFIR MR754	CR14-17	4
2 CR9,10 POSITION CHANGE ON BV UNITS			
3 ON M488:			
R14 ON BACK, R31 ONLY USED ON M488			
50525-32	RESISTOR, MF 1.62k OHM ¼W 1%	R12	1
50525-33	RESISTOR, MF 3.48k OHM ¼W 1%	R10,11	2
50325-36	RESISTOR, MF 4.64k OHM ¼W 1%	R7	1
50702-12	POTENTIOMETER, 1m 20 TURN 3006P-1-105 BOURNS	R31	1
R8 REPLACED BY JUMPER		R3 REPLACED BY JUMP	

ASSEMBLY DESCRIPTION: A2-1 REAL CURRENT DETECT AV/BV P. C. BOARD
ASSEMBLY NUMBER: 00442-02 REV. D

P/N	DESCRIPTION	REFERENCE	QTY
00442-03	PCB, RAW	A2-1	1
50209-01	CAPACITOR, DISC .002µF 25V	C20	1
50066-03	CAPACITOR, MONOLYTHIC .01µF 50V	C1,3-12,16,17	13
50066-07	CAPACITOR, MONOLYTHIC .47µF 50V	C2	1
50060-01	CAPACITOR, TANTALUM 1µF 35V	C18,19	2
50320-01	CAP., ELECTROLYTIC 47µF 25V	C13-15,21,22	5
50125-08	RESISTOR, CC. 100 OHM ¼W 5%	R25	1
50125-21	RESISTOR, CC 330 OHM ¼W 5%	R15	1
50125-31	RESISTOR, CC 1k OHM ¼W 5%	R11,16,17,19-21	6
50125-40	RESISTOR, CC 4.7k OHM ¼W 5%	R28,32	2
50125-44	RESISTOR, CC 10k OHM ¼W 5%	R13,18,23,24	4
50125-46	RESISTOR, CC 15k OHM ¼W 5%	R30	1
50125-79	RESISTOR, CC 20k OHM ¼W 5%	R27	1
50125-53	RESISTOR, CC 47k OHM ¼W 5%	R22,26	2
50125-55	RESISTOR, CC 56k OHM ¼W 5%	R31	1
50125-87	RESISTOR, CC 87k OHM ¼W 5%	R38	1
50125-59	RESISTOR, CC 100k OHM ¼W 5%	R10,14,34,35	4
50325-48	RESISTOR, MF 100k OHM ¼W 1%	R36	1
50125-74	RESISTOR, CC 680k OHM ¼W 5%	R12	1
50025-61	RESISTOR, CC 10m OHM ¼W 5%	R33	1
50702-04	POTENTIOMETER, 1k 20 TURN 3006P-1-102 BOURNS	R29	1
50702-07	POTENTIOMETER, 10k 20 TURN 3006P-1-103 BOURNS	R1,2,5-9	7
50702-08	POTENTIOMETER, 20k 20 TURN 3006P-1-203 BOURNS	R4	1
50702-09	POTENTIOMETER, 25k 20 TURN 3006P-1-253 BOURNS	R37	1
50702-11	POTENTIOMETER, 100k 20 TURN 3006P-1-104 BOURNS	R3	1
50334-10	RESISTOR PACK,8p4rSIP 1k OHM 8 B DALE	RN2,3	2
50337-01	RESISTOR PACK,8p4rSIP 2.2k OHM 8 B DALE	RN7	1
50335-02	RESISTOR PACK,8p4rSIP 4.7k OHM 8 B DALE	RN1	1
50335-01	RESISTOR PACK,8p4rSIP 10k OHM 8 B DALE	RN6	1
50336-01	RESISTOR PACK,8p4rSIP 100k OHM 8 B DALE	RN4,5	2
50036-01	DIODE, SIGNAL 1N914B	CR1-4,7,8	6
50044-01	DIODE, 4.7V ZENER 1N750	CR5,6,9,10	4
50267-01	TRANSISTOR, NPN SSMTL 2N2222	Q1,2	2
50269-01	TRANSISTOR, PNP SSMTL 2N2907	Q3	1
50128-01	IC, QUAD OP AMP LOPWR LM324	U6	1
50103-01	IC, DUAL OP AMP UA747	U1-3	3
50110-01	IC, QUAD 2IN NAND CD4011	U8	1
50070-01	IC, QUAD BILATERAL SW CD4066	U5	1
50124-01	IC, MONOL SAMPL & HLD LF398	U4	1
50093-01	IC, QUAD TIMER NE558	U7	1
50264-08	SOCKET, IC 8 PIN LOPROFILE CDH-4000-08-B SAE	U4	1
50264-14	SOCKET, IC 14 PIN LOPROFILE CDH-4000-14-B SAE	U1-3,5,6,8	6
50264-16	SOCKET, IC 16 PIN LOPROFILE CDH-4000-16-B SAE	U7	1
50151-01	PIN, TEST 1405-3 KEYSTONE	TP1-12	12
C23 NOT USED			





QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

CONTRACT NO.

APPROVALS	DATE
DRAWN E. Taylor	1-23-72
CHECKED	

MATERIAL

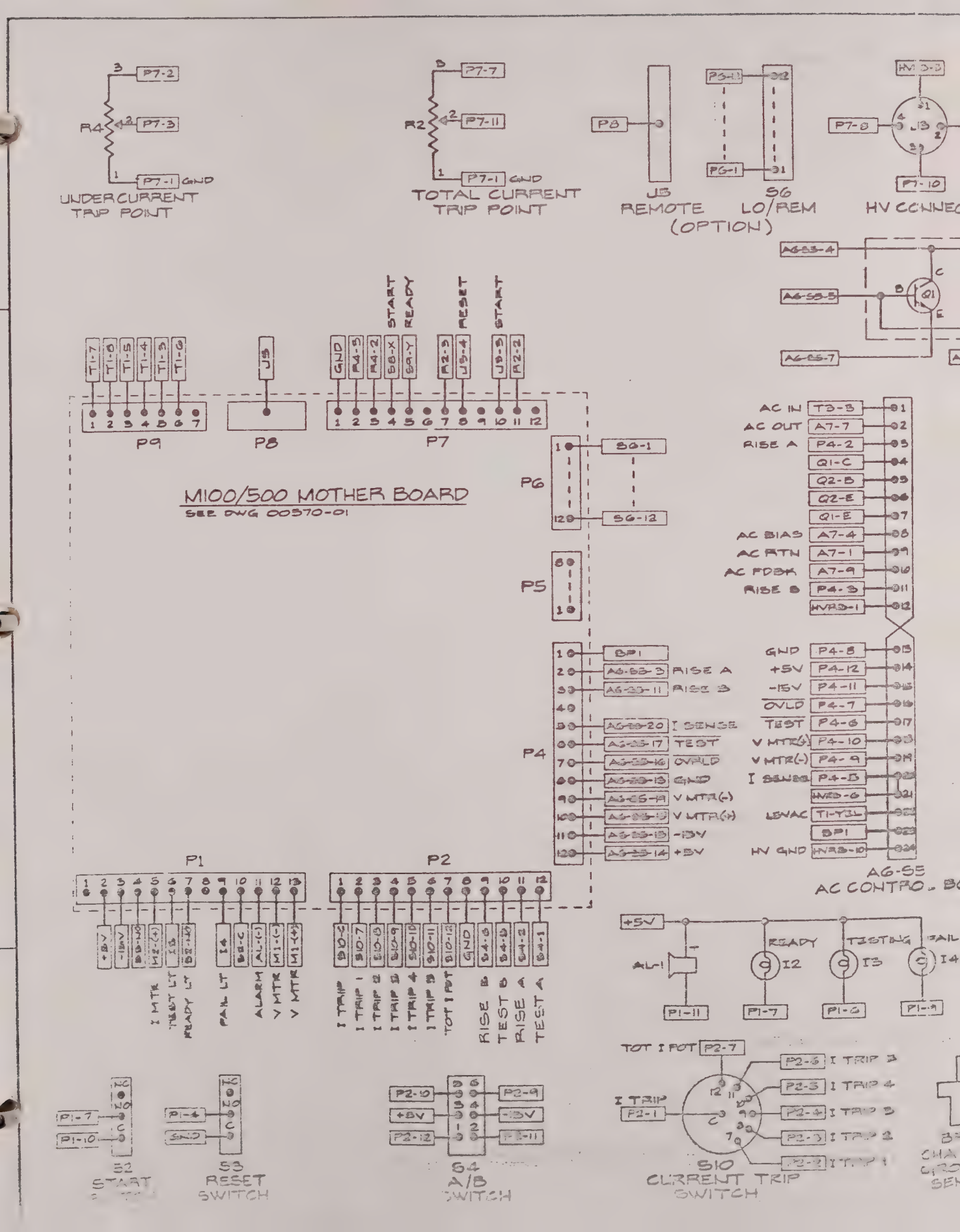
FINISH

00237-05 | M100AV-55

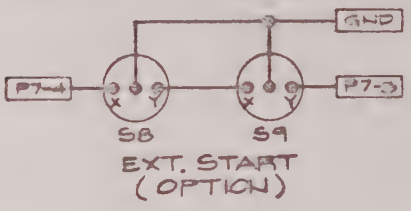
ROD-L ELECTRONICS, INC.

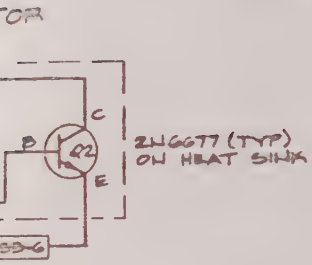
M100/M500 AV-55 MAIN CHASSIS ASSEMBLY

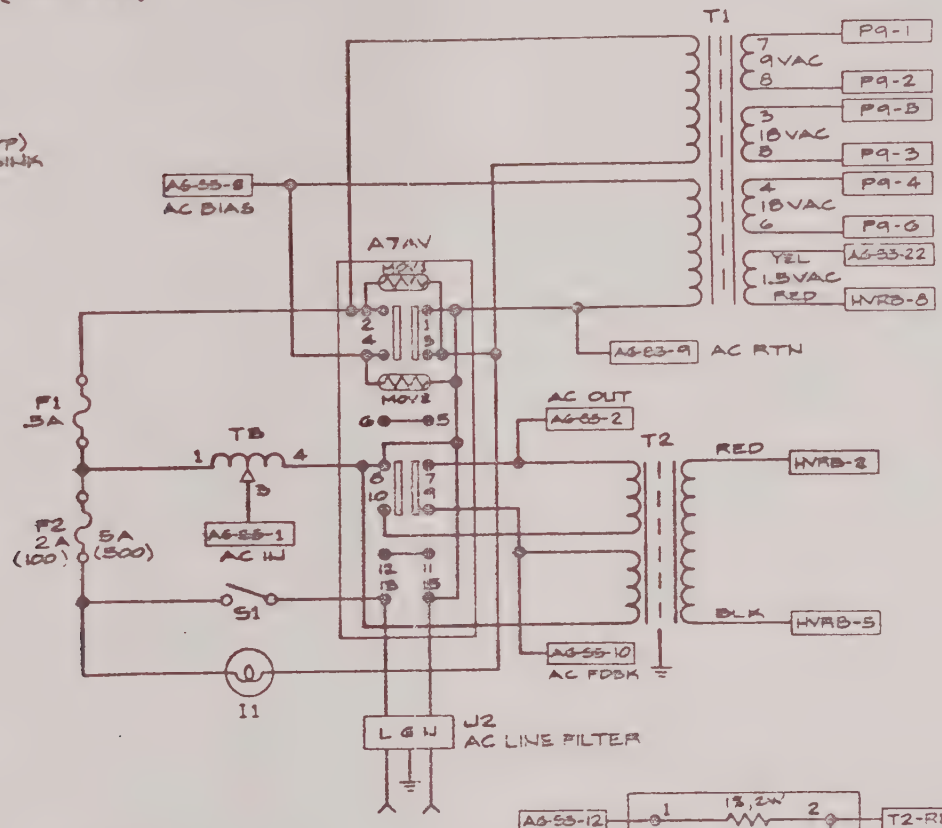
SIZE | CODE IDENT NO. | DRAWING NO.

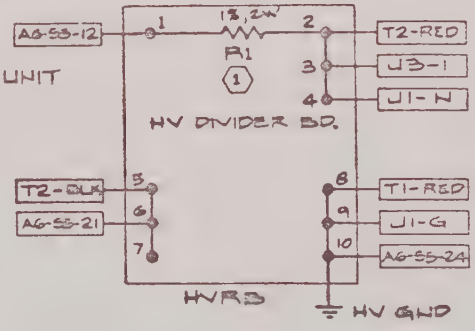

R4
P7-2
P7-3
P7-1
GND
UNDER CURRENT TRIP POINT
R2
P7-7
P7-11
P7-1
GND
TOTAL CURRENT TRIP POINT
P8
J8
REMOTE (OPTION)
P31
P1
P32
P30
S6
LO/REM
HV CONNEC
P7-8
P7-10
AG-S3-4
AG-S5-5
AG-S5-7
Q1
C
B
E
P9
P8
P7
T1-7
T1-6
T1-5
T1-4
T1-3
T1-2
J8
GND
R4-5
R4-2
S8-X
S9-Y
START
READY
R2-3
J8-4
RESET
J8-3
START
R2-2
M100/500 MOTHER BOARD
SEE DWG 00570-01
P6
P5
P4
S9-1
S6-12
BP1
AG-S3-3
AG-S3-11
AG-S3-20
AG-S3-17
AG-S3-16
AG-S3-13
AG-C5-9
AG-C5-12
AG-S3-15
AG-S3-14
I SENSE
TEST
OVLD
GND
V MTR(-)
V MTR(+)
-15V
+5V
RISE A
RISE B
AC IN
AC OUT
RISE A
AC BIAS
AC RTN
AC FDBK
RISE B
T3-3
A7-7
P4-2
Q1-C
Q2-B
Q2-E
Q1-E
A7-4
A7-1
A7-9
P4-3
HVR3-1
P4-8
P4-12
P4-11
P4-7
P4-6
P4-10
P4-9
P4-5
HVR3-6
T1-T3L
BP1
HVR3-10
HV GND
LSVAC
AG-S5
AC CONTRO
P1
P2
+5V
-15V
I MTR
TEST LT
READY LT
FAIL LT
ALARM
V MTR(-)
V MTR(+)
I TRIP
I TRIP 1
I TRIP 2
I TRIP 3
I TRIP 4
I TRIP 5
TOT I POT
RISE B
TEST B
RISE A
TEST A
+5V
AL-1
READY
I2
TESTING
I3
FAIL
I4
P1-11
P1-7
P1-6
P1-9
TOT I POT
P2-7
I TRIP
P2-1
P2-6
P2-5
P2-4
P2-3
P2-2
S10
CURRENT TRIP SWITCH
P1-7
P1-10
S2
START
P1-4
GND
S3
RESET SWITCH
P2-10
+5V
P2-12
P2-9
-15V
P2-11
S4
A/B SWITCH

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE	10-2-03	DILL

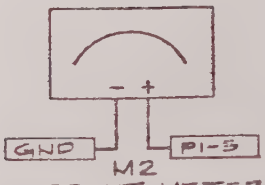


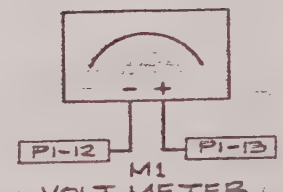


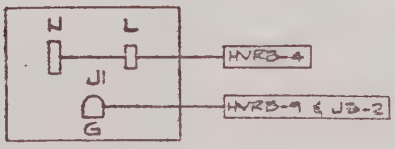




(1) R1 - 1.2M FOR 1.5KV & 2.8KV UNIT
3M FOR 5KV UNIT



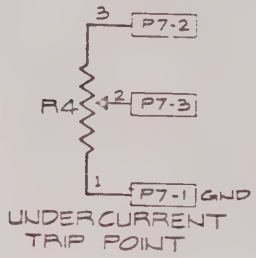


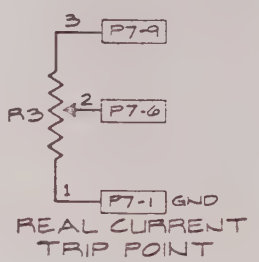


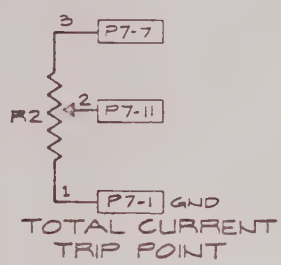
P4-1 & AG-55-23

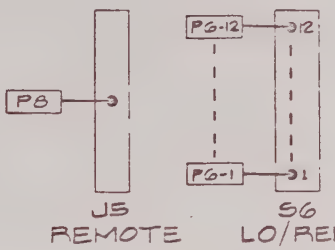
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX		APPROVALS	DATE
				JJN	10-3-03
	AC HIPOT	MATERIAL			
		FINISH			

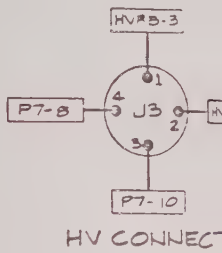
WIRING DIAGRAM
M100/300 AVSS

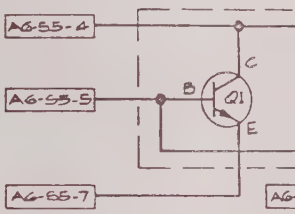


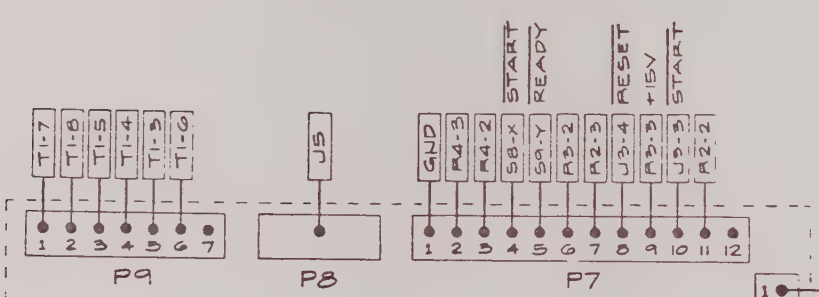




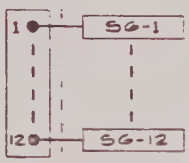


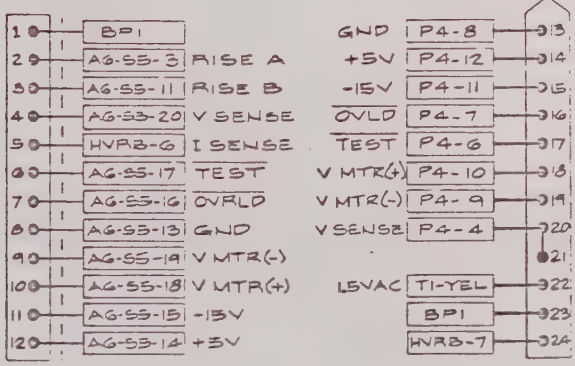




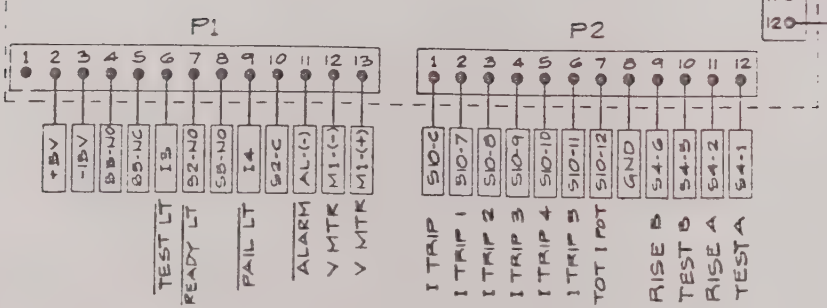


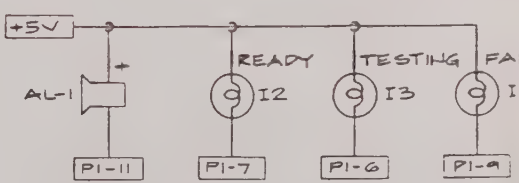
M100/500 MOTHER BOARD
SEE DWG 00570-01

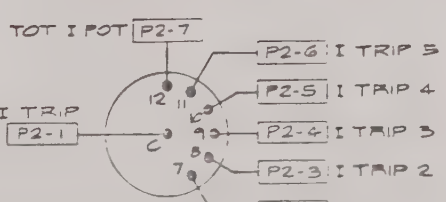


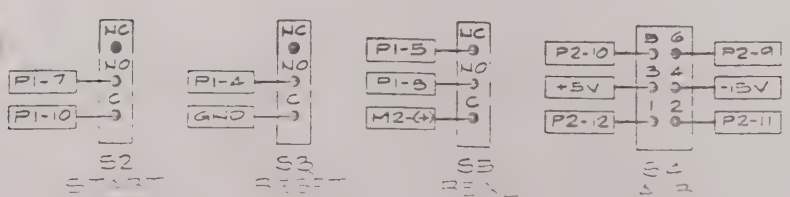


AG-S5
AC CONTROL BO

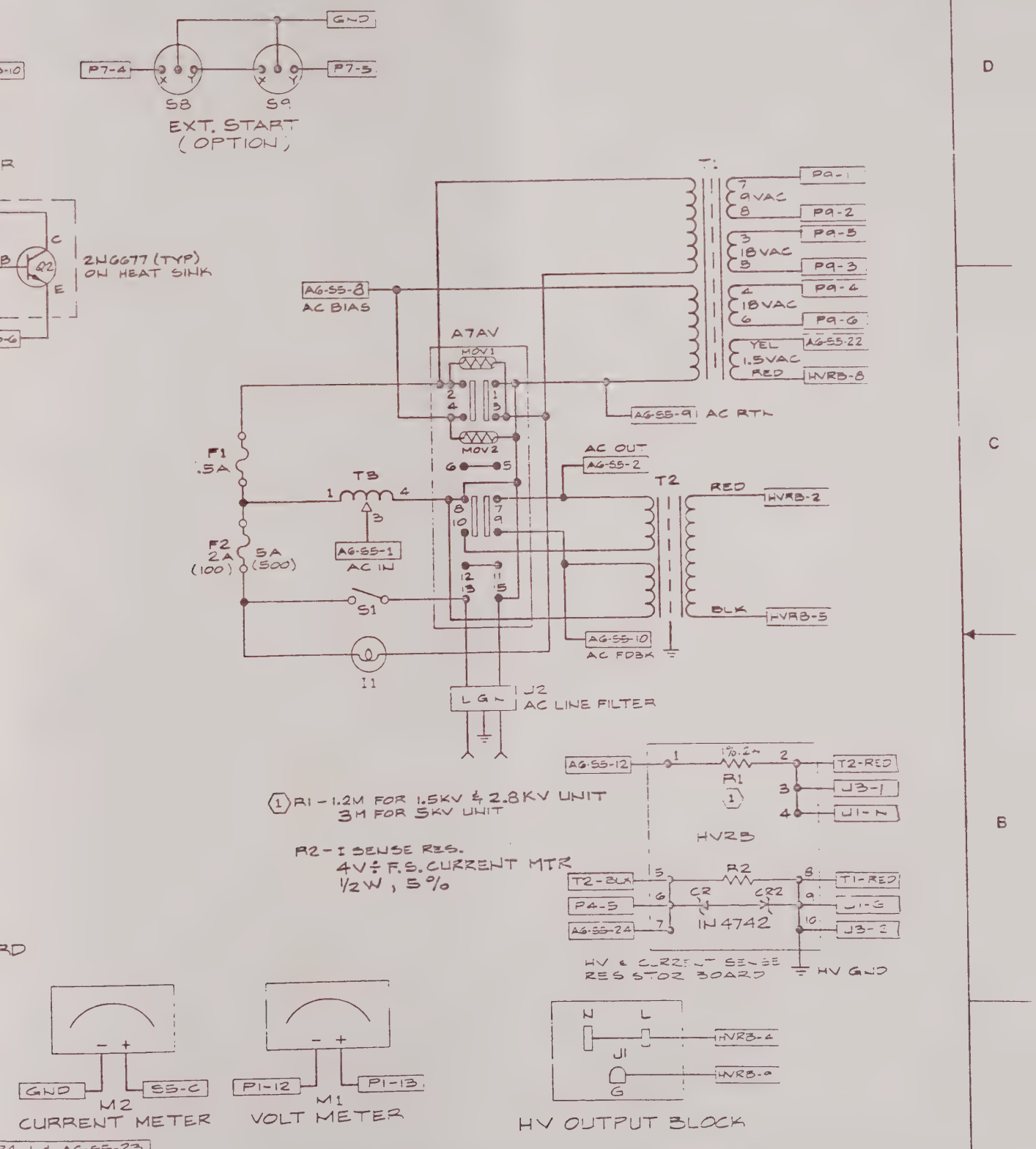








REVISIONS			
ZONE / REV	DESCRIPTION	DATE	APPROVED
A	INITIAL RELEASE	12-2-85	BILL



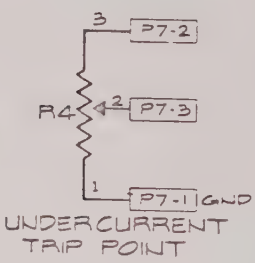
(1) R1 - 1.2M FOR 1.5KV & 2.8KV UNIT
3M FOR 5KV UNIT

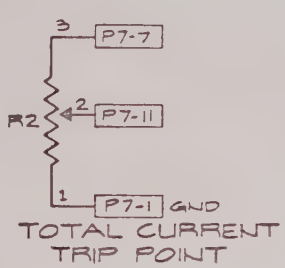
P4-1 & AG-S5-23

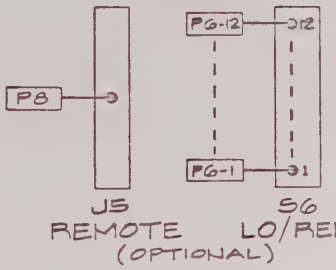
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX	CONTRACT NO		
	APPROVALS	DATE	
MATERIAL	DRAWN JUN	6-2-85	
AC HIPOT			

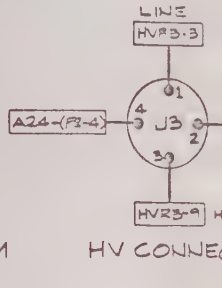
ELECTRONICS, INC.

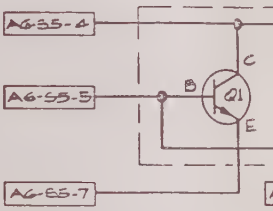
WIRING DIAGRAM
M100/500 BVS5

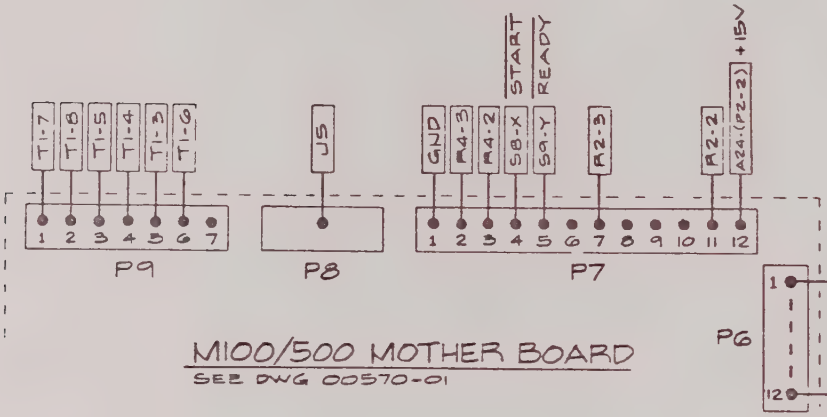

3
P7-2
R4
2
P7-3
1
P7-1
GND
UNDERCURRENT
TRIP POINT

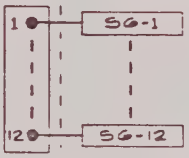

3
P7-7
R2
2
P7-11
1
P7-1
GND
TOTAL CURRENT
TRIP POINT

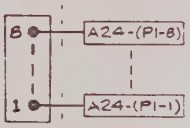

P8
J5
REMOTE
(OPTIONAL)
P6-12
P6-1
S6
LO/REM

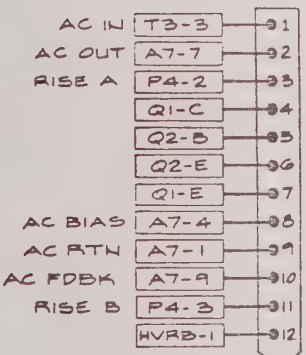

LINE
HVRB-3
A24-(P2-4)
J3
HVRB-9
HV CONNE

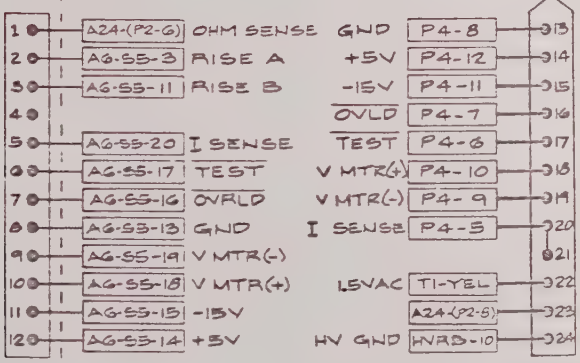

AG-S5-4
AG-S5-5
AG-E5-7
Q1
C
B
E

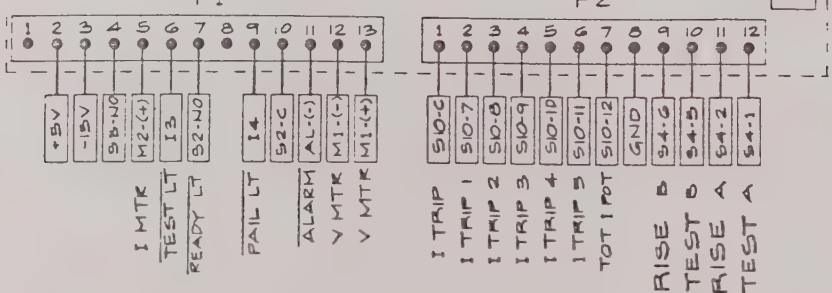

T1-7
T1-8
T1-5
T1-4
T1-3
T1-6
J5
GND
R4-3
R4-2
S8-X
START
S9-Y
READY
R2-3
R2-2
A24-(P2-2)
+15V
P9
P8
P7
M100/500 MOTHER BOARD
SEE DWG 00570-01

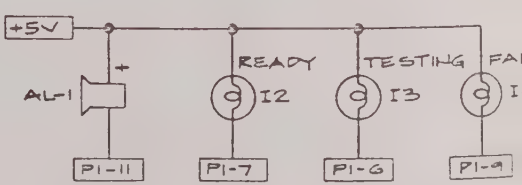

P6
1
S6-1
12
S6-12

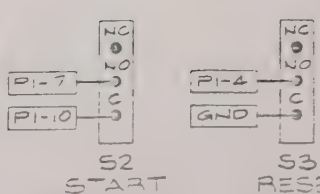

P5
8
A24-(P1-8)
1
A24-(P1-1)

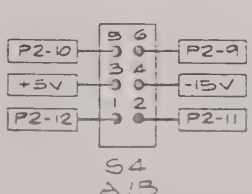

AC IN
T3-3
AC OUT
A7-7
RISE A
P4-2
Q1-C
Q2-B
Q2-E
Q1-E
AC BIAS
A7-4
AC RTN
A7-1
AC FDBK
A7-9
RISE B
P4-3
HVRB-1

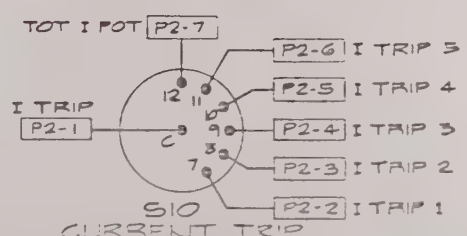

P4
A24-(P2-6)
OHM SENSE
AG-S5-3
RISE A
AG-S5-11
RISE B
AG-S5-20
I SENSE
AG-S5-17
TEST
AG-S5-16
OVRLD
AG-S5-13
GND
AG-S5-19
V MTR(-)
AG-S5-18
V MTR(+)
AG-S5-15
-15V
AG-S5-14
+5V
GND
P4-8
+5V
P4-12
-15V
P4-11
OVLD
P4-7
TEST
P4-6
V MTR(+)
P4-10
V MTR(-)
P4-9
I SENSE
P4-5
L5VAC
T1-YEL
A24-(P2-5)
HV GND
HVRB-10
AG-S5
AC CONTROL B


P1
P2
+5V
-15V
S8-NO
M2-(+)
I3
S2-NO
I4
S2-C
AL-(-)
M1-(-)
M1-(+)
I MTR
TEST LT
READY LT
FAIL LT
ALARM
V MTR
V MTR
S10-6
S10-7
S10-8
S10-9
S10-10
S10-11
S10-12
GND
S4-6
S4-5
S4-2
S4-1
I TRIP
I TRIP 1
I TRIP 2
I TRIP 3
I TRIP 4
I TRIP 5
TOT I POT
RISE B
TEST B
RISE A
TEST A


+5V
AL-1
+
READY
I2
TESTING
I3
FAIL
I4
P1-11
P1-7
P1-6
P1-9


P1-7
P1-10
NC
NO
C
S2
START
P1-4
GND
S3
RESET


P2-10
+5V
P2-12
P2-9
-15V
P2-11
S4
A/B


TOT I POT
P2-7
I TRIP
P2-1
C
P2-6
I TRIP 5
P2-5
I TRIP 4
P2-4
I TRIP 3
P2-3
I TRIP 2
P2-2
I TRIP 1
S10
CURRENT TRIP

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE	10-25-85	BILL

GND
P7-4
P7-3
S8
S9
EXT. START
(OPTIONAL)

A24-W3
EUTRAL

GND
TOR

C
B
Q2
E
2N6677 (TYP)
ON HEAT SINK

T1
P9-1
7
9VAC
8
P9-2
P9-5
3
18VAC
5
P9-3
P9-4
4
18VAC
6
P9-6
YEL
1.5VAC
RED
AG-S5-22
HVRB-8

AG-S5-8
AC BIAS

A7AV
MOV1
MOV2

AG-S5-9 AC RTN

P3-8
P3-1
P1
P4-1
U3-4
BP1
+15V
P7-12
P2
V GND
LINE
TRAL
HVRB-9
HVRB-4
U3-2
W1
W2
W3

F1
.5A
F2
2A
(100)
5A
(500)
TB
AG-S5-1
AC IN
S1
I1

AC OUT
AG-S5-2
T2
RED
HVRB-2
BLK
HVRB-5
AG-S5-10
AC FDBK

L G N
J2
AC LINE FILTER

A24
OHM SENSE
BOARD

(1) R1 - 1.2M FOR 1.5KV & 2.8KV UNIT
3M FOR 5KV UNIT

AG-S5-12
1%, 2W
R1
(1)
T2-RED
U3-1
A24-W2
HV DIVIDER BD.
T2-BLK
AG-S5-21
T1-RED
U3-3 & A24-W1
AG-S5-24
HVRB
HV GND

ARD

GND
P1-5
M2
CURRENT METER
P1-12
P1-13
M1
VOLT METER

A24-(P2-3)

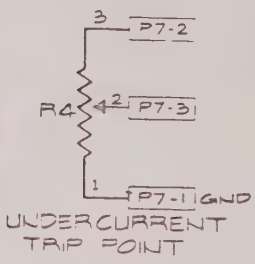
SIS
ND

	AC HIPOT		

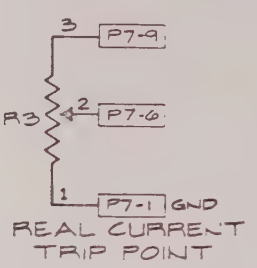
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
XX
XXX
MATERIAL
CONTRACT NO
APPROVALS DATE
DRAWN JUN 10-25-85
DESIGNED

ELECTRONICS, INC.

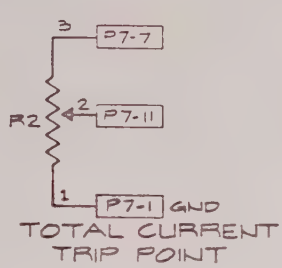
WIRING DIAGRAM
M100/500 AVSS
WITH OHM SENSE



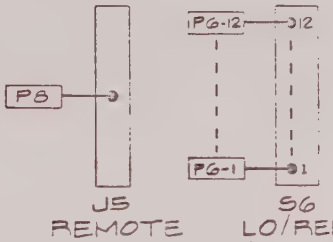
UNDERCURRENT TRIP POINT



REAL CURRENT TRIP POINT

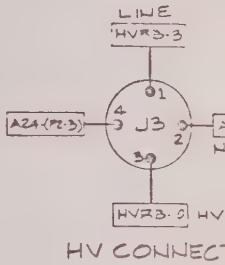


TOTAL CURRENT TRIP POINT

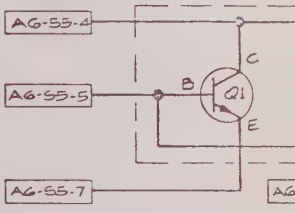


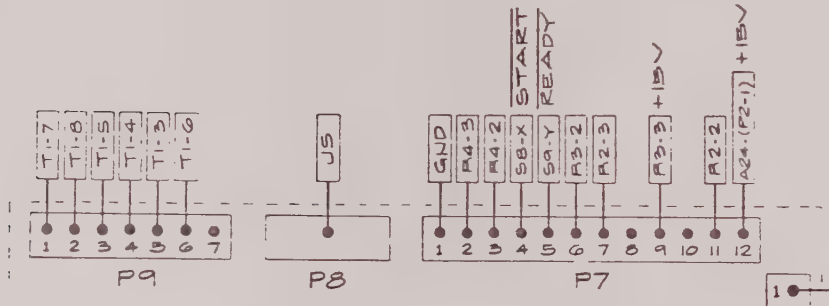
J5 REMOTE (OPTIONAL)

S6 LO/REM



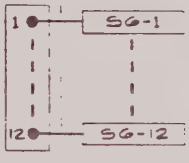
HV CONNEC

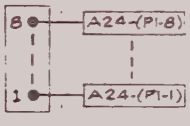


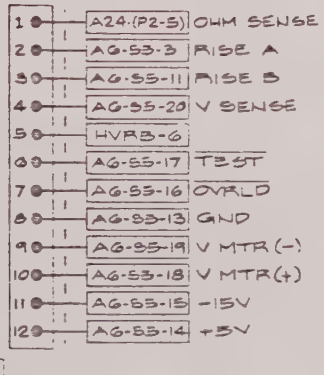


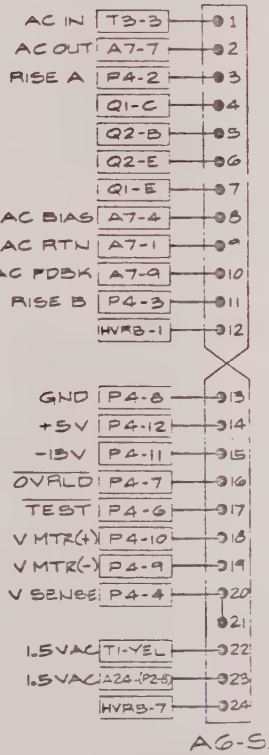
M100/500 MOTHER BOARD

SEE DWG # 00570-01

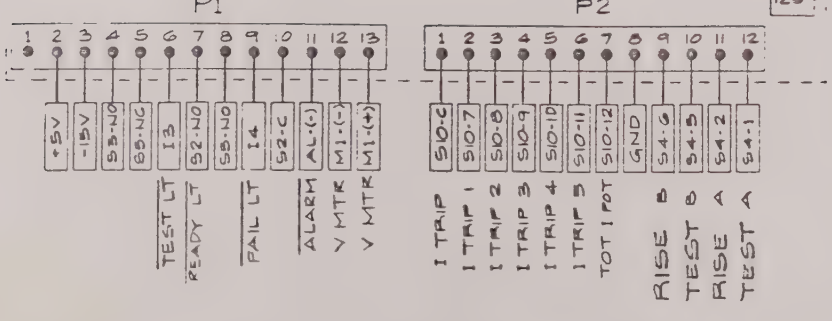


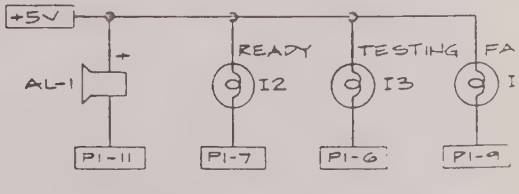


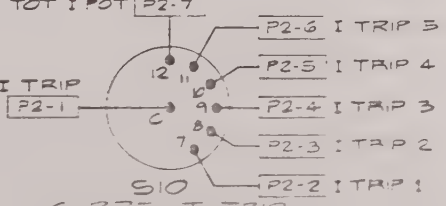




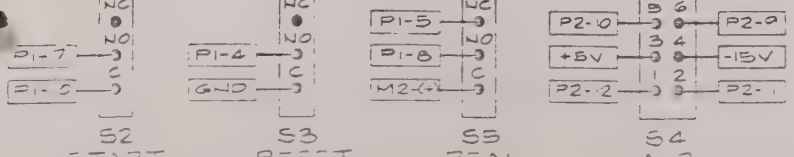
AG-S5 AC CONTROL BO



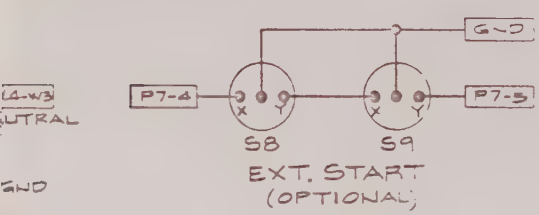


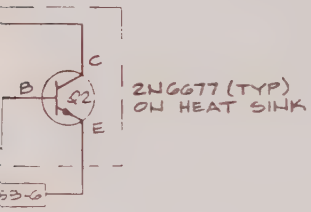


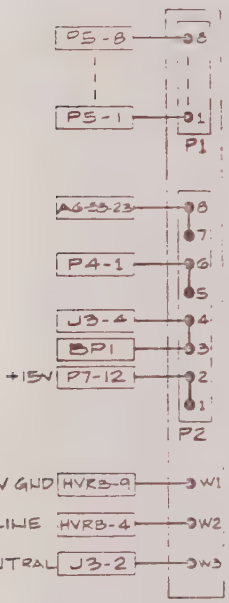
S10 CURRENT TRIP

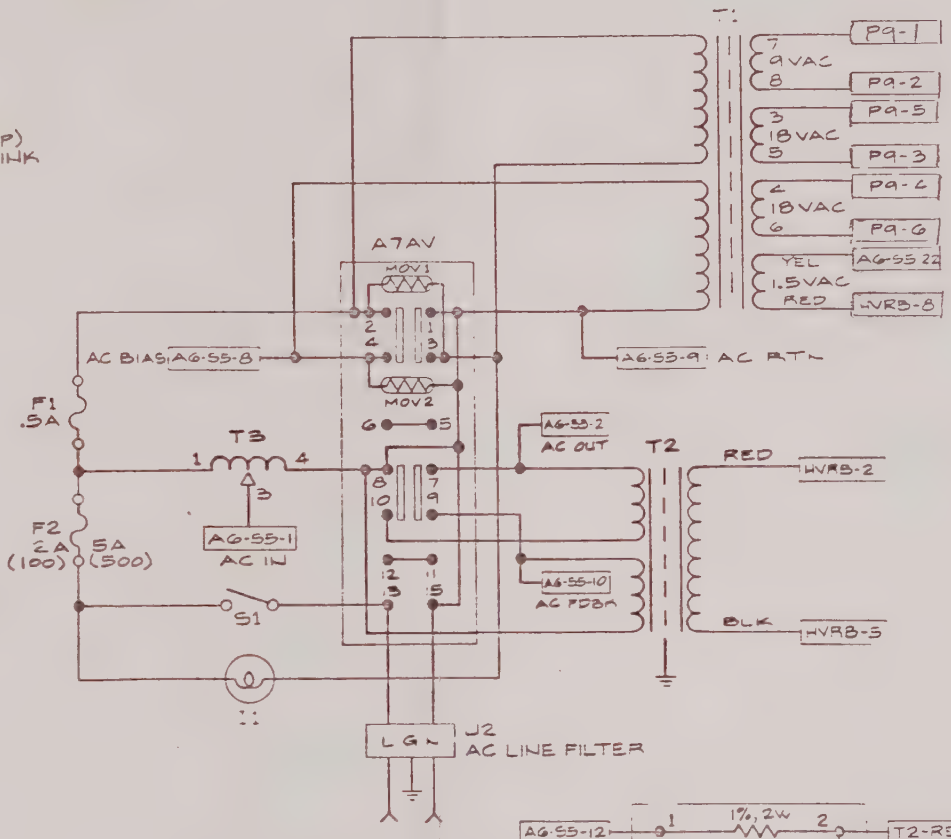


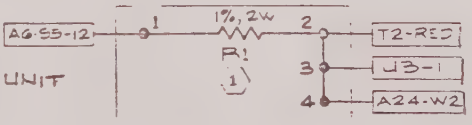
REVISIONS			
ZONE	REV	DESCRIPTION	DATE / APPROVED
	A1	INITIAL RELEASE	9-27-85 BILL





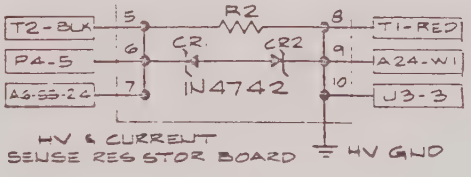


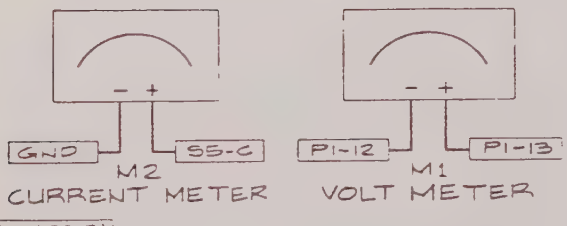




(1) R1 - 1.2M FOR 1.5KV & 2.8 KV UNIT
3M FOR 5 KV UNIT

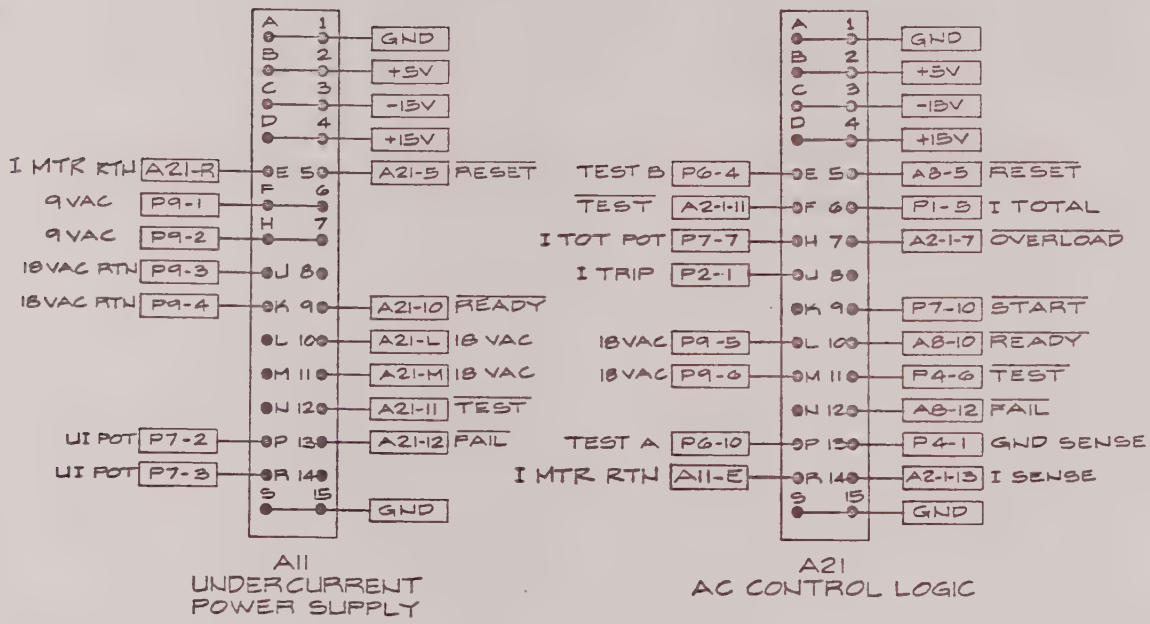
R2 - I SENSE RES.
4V ÷ F.S. CURRENT
METER, 1/2W, 5%

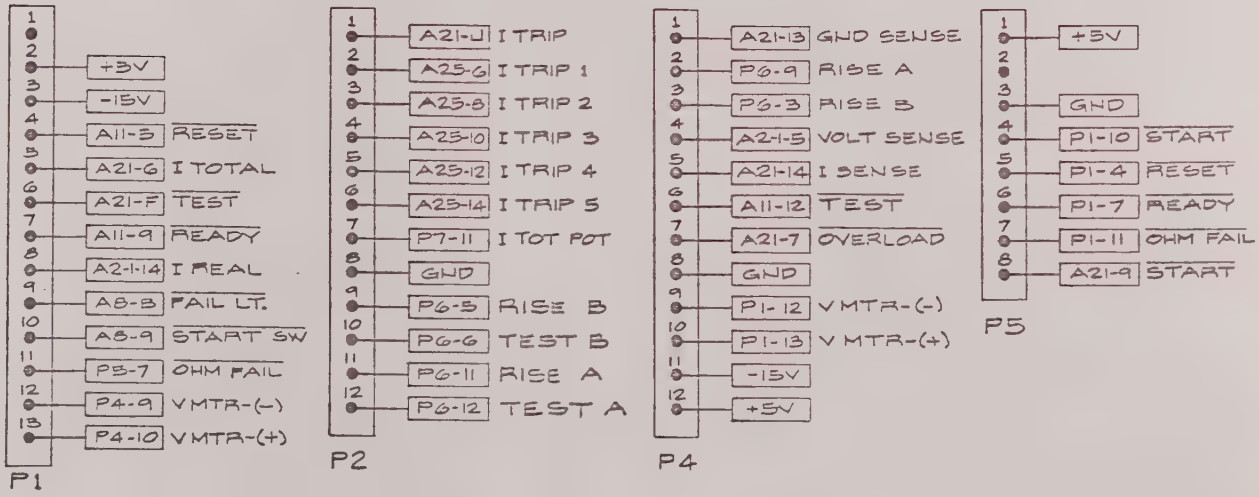


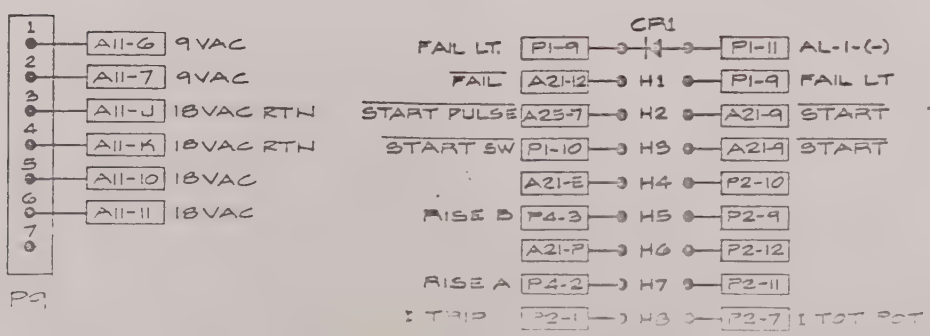


A24-(P2-3)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX	CONTRACT NO	ELECTRONICS, INC.
MATERIAL	APPROVALS / DATE	NIRING DIAGRAM M100,500 BVSS WITH O-M SENSE
AC - BT	DRAWN JUN 17-10-85	
	DESIGN	


A11
UNDERCURRENT
POWER SUPPLY
A21
AC CONTROL LOGIC
A2-1
REAL CURRE
(OPTIONAL)
GND
+5V
-15V
+15V
I MTR RTN A21-R
9 VAC P9-1
9 VAC P9-2
18 VAC RTN P9-3
18 VAC RTN P9-4
UI POT P7-2
UI POT P7-3
A21-5 RESET
A21-10 READY
A21-L 18 VAC
A21-M 18 VAC
A21-11 TEST
A21-12 FAIL
TEST B P6-4
TEST A2-1-11
I TOT POT P7-7
I TRIP P2-1
18 VAC P9-5
18 VAC P9-6
TEST A P6-10
I MTR RTN A11-E
A8-5 RESET
P1-5 I TOTAL
A2-1-7 OVERLOAD
P7-10 START
A8-10 READY
P4-6 TEST
A8-12 FAIL
P4-1 GND SENSE
A2-1-13 I SENSE
P7-6

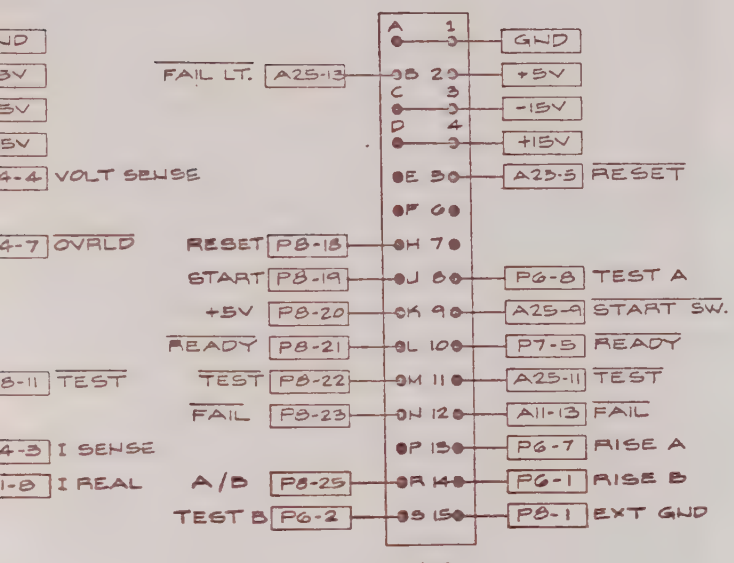

P1
+5V
-15V
A11-5 RESET
A21-6 I TOTAL
A21-F TEST
A11-9 READY
A2-1-14 I REAL
A8-B FAIL LT.
A8-9 START SW
P3-7 OHM FAIL
P4-9 VMTR-(-)
P4-10 VMTR-(+)
P2
A21-J I TRIP
A25-6 I TRIP 1
A25-8 I TRIP 2
A25-10 I TRIP 3
A25-12 I TRIP 4
A25-14 I TRIP 5
P7-11 I TOT POT
GND
P6-5 RISE B
P6-6 TEST B
P6-11 RISE A
P6-12 TEST A
P4
A21-13 GND SENSE
P6-9 RISE A
P6-3 RISE B
A2-1-5 VOLT SENSE
A21-14 I SENSE
A11-12 TEST
A21-7 OVERLOAD
GND
P1-12 VMTR-(-)
P1-13 VMTR-(+)
-15V
+5V
P5
+5V
GND
P1-10 START
P1-4 RESET
P1-7 READY
P1-11 OHM FAIL
A21-9 START


P9
A11-6 9 VAC
A11-7 9 VAC
A11-J 18 VAC RTN
A11-K 18 VAC RTN
A11-10 18 VAC
A11-11 18 VAC
CR1
FAIL LT. P1-9
FAIL A21-12
START PULSE A25-7
START SW P1-10
A21-E
RISE B P4-3
A21-P
RISE A P4-2
I TRIP P2-1
H1 P1-9 FAIL LT
H2 A21-9 START
H3 P2-7 I TOT POT
H4 P2-10
H5 P2-9
H6 P2-12
H7 P2-11
P1-11 AL-1-(-)

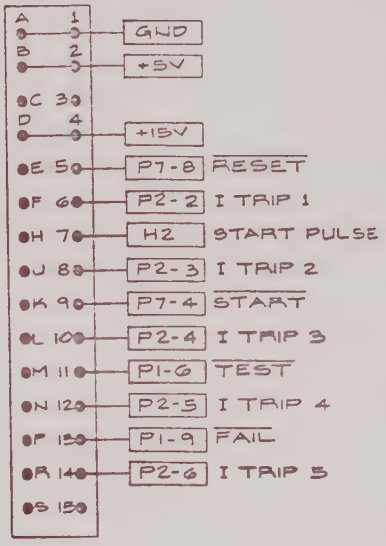
DWG NO	SH	REV
DWG NO		

REVISIONS

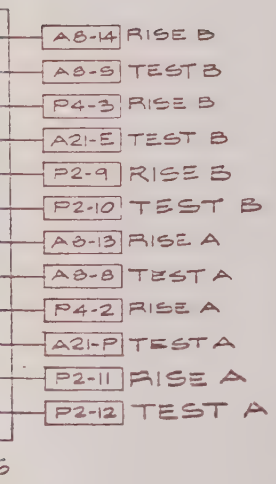
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE	8-85	

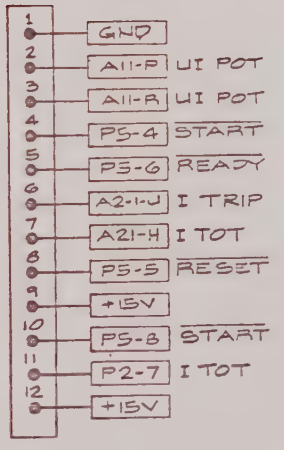


A8
REMOTE
(OPTIONAL)

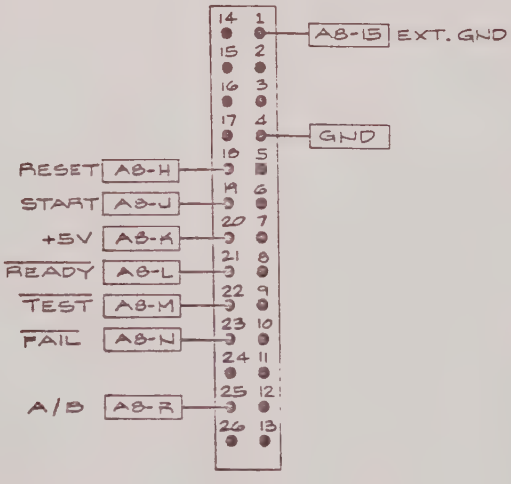


A25
HANDS-OFF
(OPTIONAL)



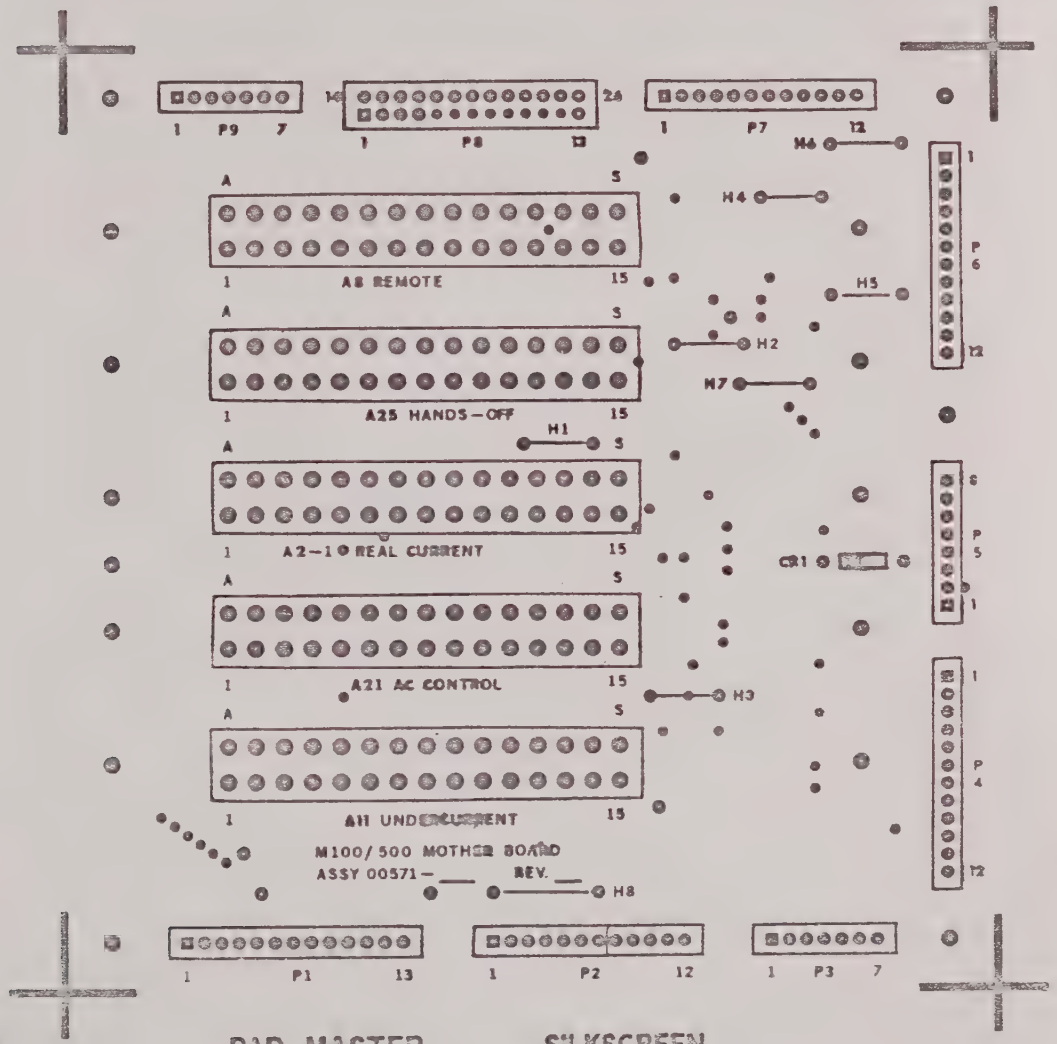


P7



P8

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX	CONTRACT NO.	ELECTRONICS, INC.
MATERIAL	APPROVALS / DRAWN JUN / DESIGNED	DATE 7-10-85
00571-XX AC HIPOT		WIRING INTERCONNECTION MOTHER BOARD M100/500 AC HIPOT



PAD MASTER
00573-01

SILKSCREEN
00573-04

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE	8-35	BILL

TABULATION BLOCK			
DASH #	DESCRIPTION	CONNECTORS USED	JUMPERS USED
-01	STANDARD AVS5	P1,2,4,7,9	H1,3-8,CR1
-02	AVS5 WITH A8	P1,2,4,6-9	H3,8,CR1
-03	AVS5 WITH A8, A24	P1,2,4-9	H8,CR1
-04	AVS5 WITH A25	P1,2,4,7,9	H1,2,4-7,CR1
-05	AVS5 WITH A25, A24	P1,2,4,5,7,9	H1 4-7,CR1
-06	STANDARD BVS5	P1,2,4,7,9	H1,3-8,CR1
-07	BVS5 WITH A8	P1,2,4,6-9	H3,8,CR1
-08	BVS5 WITH A8, A24	P1,2,4-9	H8,CR1
-09	BVS5 WITH A25	P1,2,4,7,9	H1,2,4-7,CR1
-10	BVS5 WITH A25, A24	P1,2,4,5,7,9	H1,4-7,CR1
-11	BVS5 WITH A8, A24, A25	P1,2,4-9	CR1
-12	AVS5 WITH A8, A24, A25	P1,2,4-9	H2,4,6,8,CR1

NOTES:

1. REFERENCE WIRING INTERCONNECTION DRAWING # 00570-01.
2. ASSY DASH NO. TO BE STAMPED AS PER TABULATION BLOCK ABOVE.
3. CR1 TO BE IN4002 WHEN EITHER AUDIBLE TESTING TONE AND A24 OHM SENSE IS USED.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±.01
.XXX ±.005

MATERIAL

FINISH

AC HIPOT

NEXT ASSY USED ON

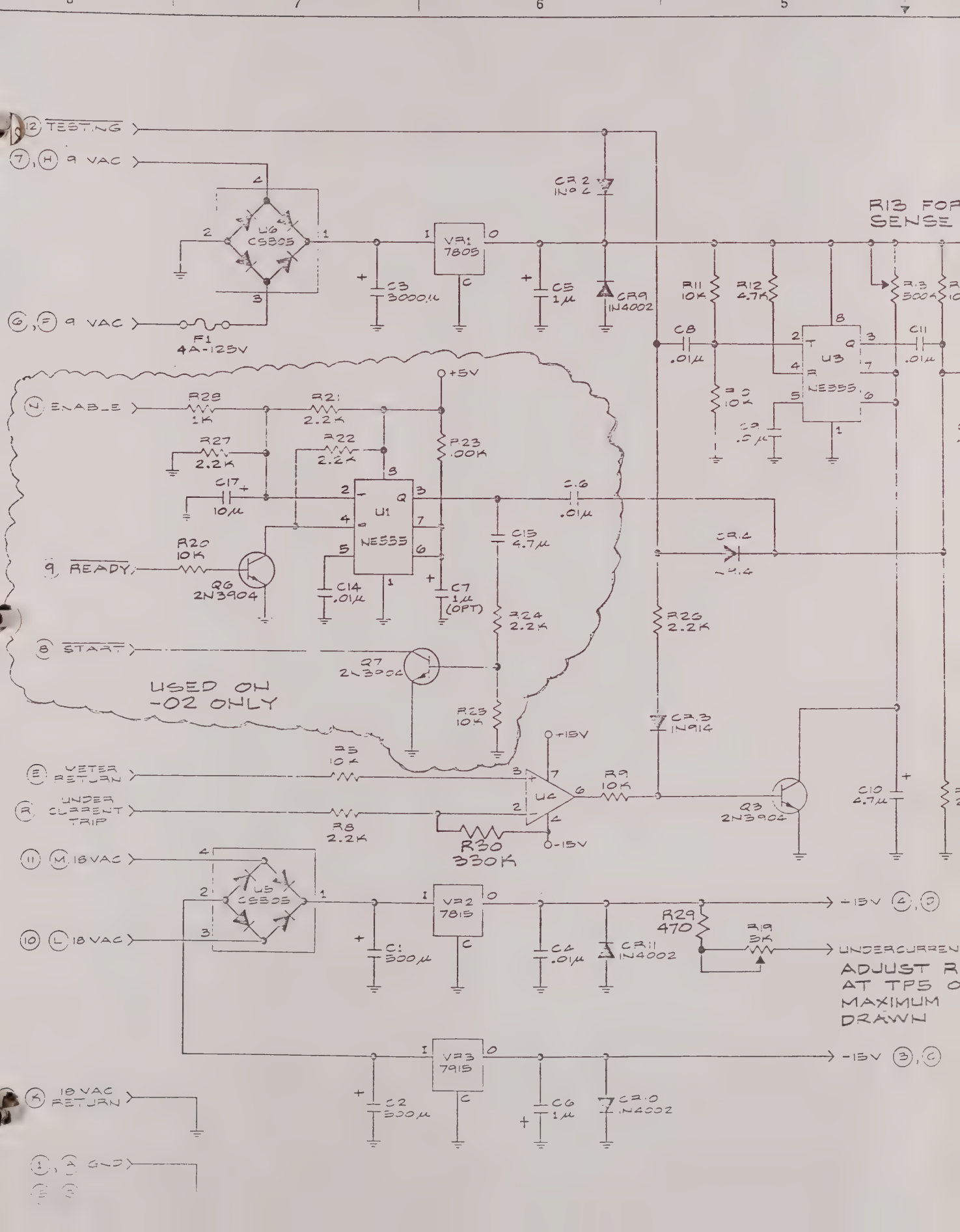
CONTRACT NO

APPROVALS	DATE
DRAWN JCK	7-29-95

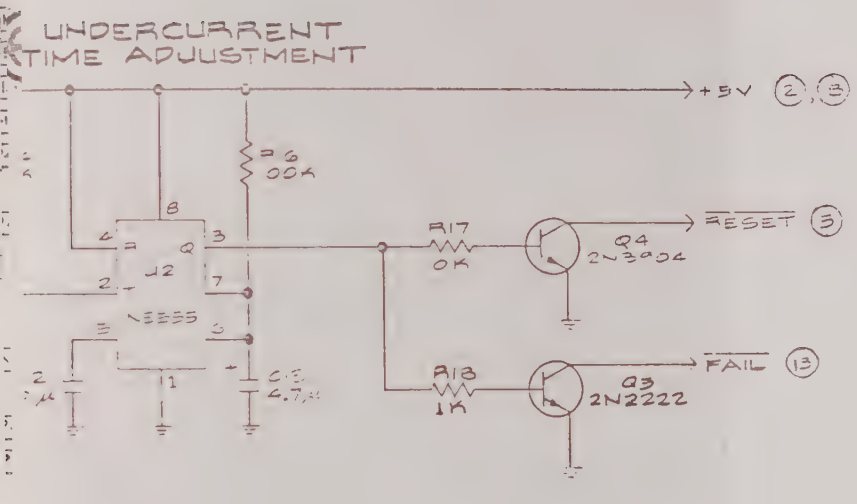
ELECTRONICS, INC.

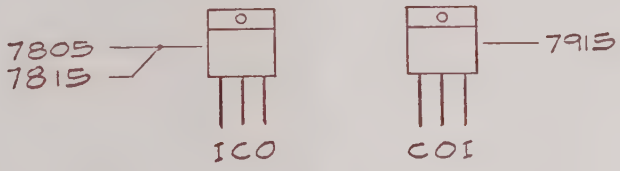
ASSEMBLY DRAWING
MOTHER BOARD
M100/500

SIZE FSCM NO DWG NO


12 TESTING
7, H 9 VAC
G, F 9 VAC
F1 4A-125V
U6 CS805
VR1 7805
C3 3000µ
C5 1µ
CR2 IN4002
CR9 IN4002
R13 FOR SENSE
R11 10K
R12 4.7K
C8 .01µ
U3 NE555
C11 .01µ
C9 .01µ
+5V
N ENABLE
R28 1K
R21 2.2K
R27 2.2K
R22 2.2K
R23 100K
C17 10µ
U1 NE555
C16 .01µ
C15 4.7µ
CR14
R20 10K
9 READY
Q6 2N3904
C14 .01µ
C7 1µ (OPT)
R24 2.2K
R26 2.2K
8 START
Q7 2N3904
USED ON -02 ONLY
R25 10K
CR13 IN914
+15V
E VETER RETURN
R
UNDER CURRENT TRIP
R5 10K
R8 2.2K
U4
R9 10K
Q3 2N3904
C10 4.7µ
R30 330K
-15V
11 M 18 VAC
10 L 18 VAC
U5 CS805
VR2 7815
C1 300µ
C4 .01µ
CR11 IN4002
R29 470
R19 5K
-15V 4, J
UNDERCURREN
ADJUST R
AT TP5 O
MAXIMUM
DRAWN
VR3 7915
C2 300µ
C6 1µ
CR10 IN4002
-15V 3, C
K 18 VAC RETURN
1, A GND
E

REVISIONS			
ZONE	REV	DESCRIPTION	DATE / APPROVED
	A	REDESIGNED	5-[illegible]-85 BILL
	B	ADDED R29 & R30	8-20-85 BILL





TABULATION BLOCK	
DASH NO.	DESCRIPTION
-01	WITHOUT HANDS-OFF
-02	WITH HANDS-OFF

TRIP (P)

FOR SAME VOLTAGE
A21 BOARD WHEN
OUTPUT CURRENT IS

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
XX ±
XXX

CONTRACT NO

APPROVALS DATE

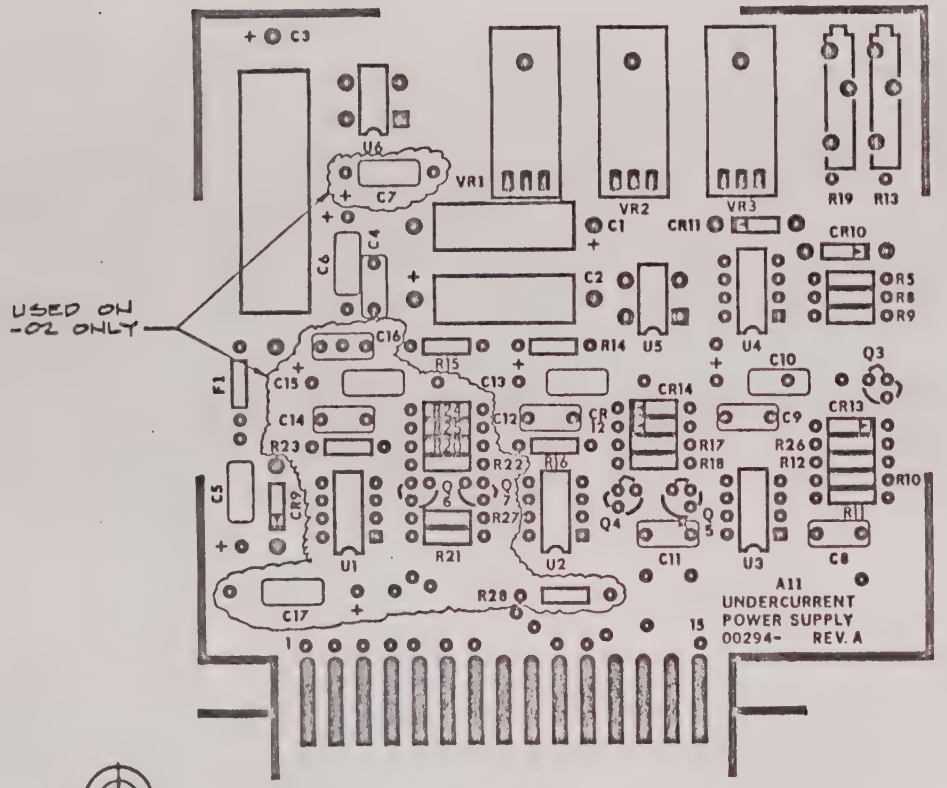
DRAWN JUN 6-11-85

MATERIAL

ELECTRONICS, INC.

SCHEMATIC
A11
UNDERCURRENT

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	B	ADDED R29, 30	8-85	BILL



PADMASTER SILKSCREEN

TABULATION BLOCK	
DASH NO.	DESCRIPTION
-01	WITHOUT HANDS-OFF
-02	WITH HANDS-OFF

NOTES:

1. REFERENCE SCHEMATIC DRAWING # 00267-XX
2. SEE PARTS LIST # 00294-XX

PARTS LIST

QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX

CONTRACT NO

MATERIAL

FINISH

DO NOT SCALE DRAWING

	APPROVALS	DATE
DRAWN	JUN	6-85
CHECKED		
ISSUED		

APPLICATION: AC HIPOT

NEXT ASSY | USED ON

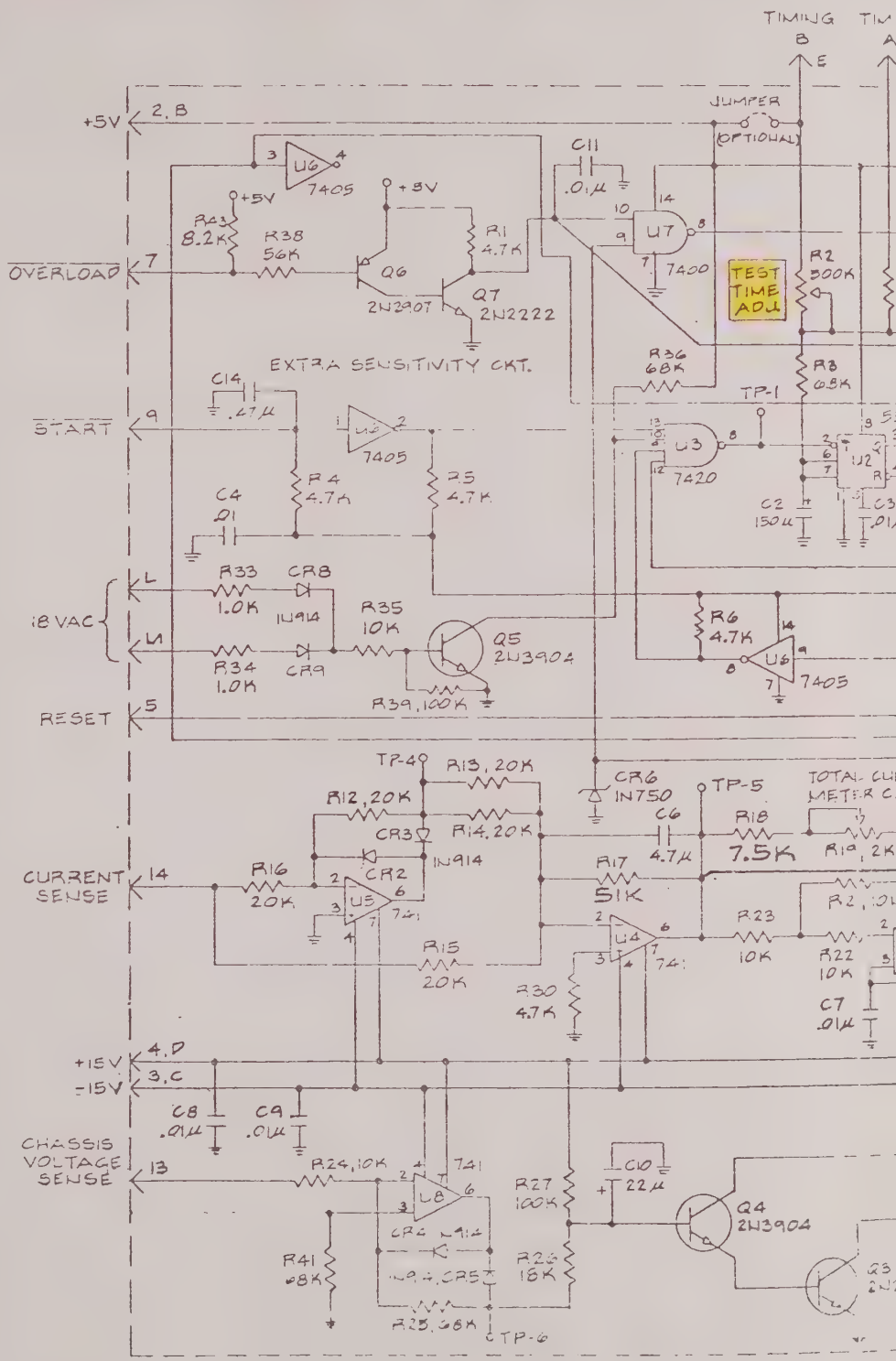
ROD-L ELECTRONICS, INC.

ASSEMBLY DRAWING
A11, UNDERCURRENT
POWER SUPPLY BOARD

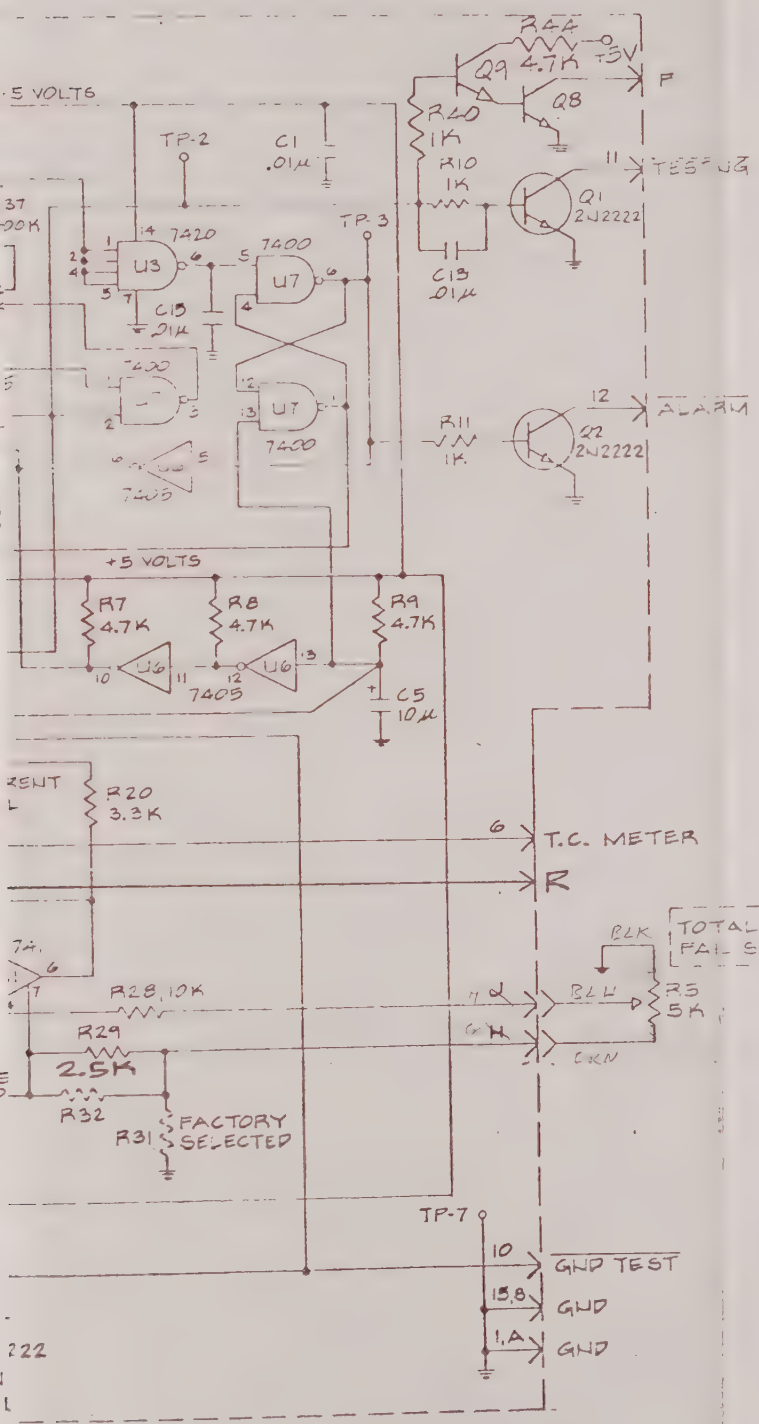
SIZE	FSCM NO	DWG NO	REV
C		00294-XX	B

SCALE 2X SHEET 1 OF 1

4 3 2 1


TIMING
B
E
JUMPER
(OPTIONAL)
+5V
2, B
U6
7405
C11
.01μ
U7
7400
TEST TIME ADJ.
R2
500K
R43
8.2K
R38
56K
R1
4.7K
OVERLOAD
7
Q6
Q7
2N2907
2N2222
EXTRA SENSITIVITY CKT.
R36
68K
R8
68K
TP-1
C14
.47μ
START
9
U2
7405
U3
7420
R4
4.7K
R5
4.7K
C4
.01
C2
150μ
L
R33
1.0K
CR8
IN914
R35
10K
18 VAC
L1
R34
1.0K
CR9
Q5
2N3904
R6
4.7K
U6
7405
R39, 100K
RESET
5
TP-4
R13, 20K
CR6
IN750
TP-5
R12, 20K
R14, 20K
C6
4.7μ
R18
7.5K
CR3
IN914
CR2
CURRENT SENSE
14
R16
20K
U5
741
R17
51K
U4
741
R23
10K
R22
10K
R15
20K
R30
4.7K
C7
.01μ
4, D
+15V
3, C
-15V
C8
.01μ
C9
.01μ
CHASSIS VOLTAGE SENSE
13
R24, 10K
U8
741
R27
100K
C10
22μ
Q4
2N3904
CR4
IN914
CR5
R41
68K
R26
18K
R25, 68K
TP-6
THIS DRAWING REPLAC
DRAWING #00236-01

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	F	REDRAWN COMPLETELY. ADDED R41, R42 TO PIN 5 OF U8; EXTRA SENSITIVITY CKT. BET. INPUT 7 AND PIN 10 OF U7	4-23-84	RAMON
	G	ADDED CONNECTIONS TO PINS 1,2,5, OF U7 AND DELETED C12, CONNECTION TO U5-4. FOR BETTER ARC SELECTION. DELETED R42. ADDED TRANSISTOR Q9 & RESISTOR R44.	7-9-84	RAMON



NOTE: JUMPER (NEAR PIN E) SHOULD BE INSERTED IN ALL BOARDS EXCEPT FOR M100AV-55. ALSO R37 DELETED IN ALL BOARDS EXCEPT M100AV-55 BOARDS.

FUNCTION TABLE

	INPUTS		LAST STATE		NEXT STATE	
	FAIL OR GND		TP-2	TP-3	TP-2	TP-3
START	+OVERLOAD	RESET	U2 PIN 3	U7 PIN 6	U2 PIN 3	U7 PIN 6
H	H	H	Q_0	Q_1	Q_0	Q_1
⩛	H	H	L	L	⎍	L
⩛	H	H	L	H	L	H
⩛	H	H	H	L	H	L
H	⩛	H	L	L	L	L
X	⩛	H	L	H	L	H
X	⩛	H	H	L	L	H
X	X	⩛	L	L	L	L
X	X	⩛	L	H	L	L
X	X	⩛	H	L	L	L
X	X	X	H	H	PROHIBITED	

SYMBOLS: H - HIGH
L - LOW
⩛ - NEG. PULSE
⎍ - POS. PULSE
X - DON'T CARE

PARTS LIST

QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

MATERIAL

FINISH

NEXT ASSY USED ON

APPROVALS DATE

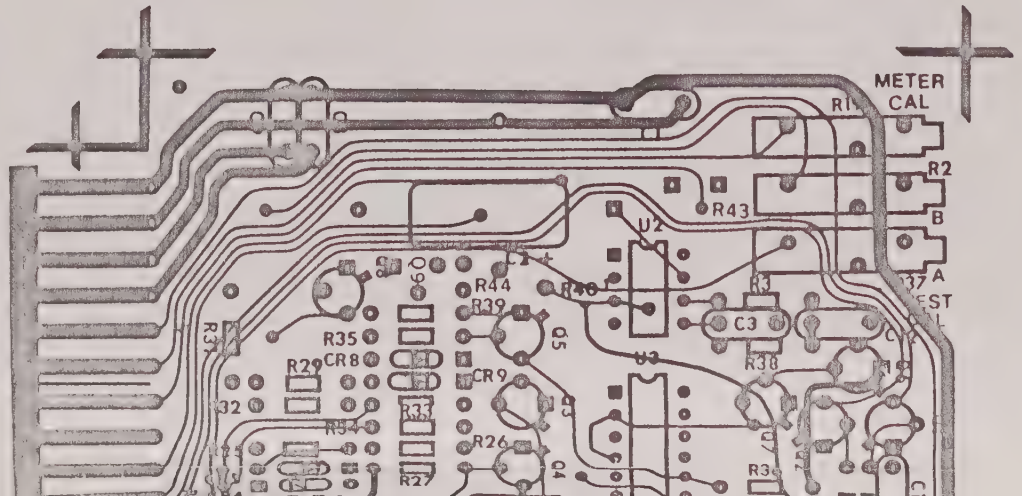
DRAWING

ELECTRONICS, INC.

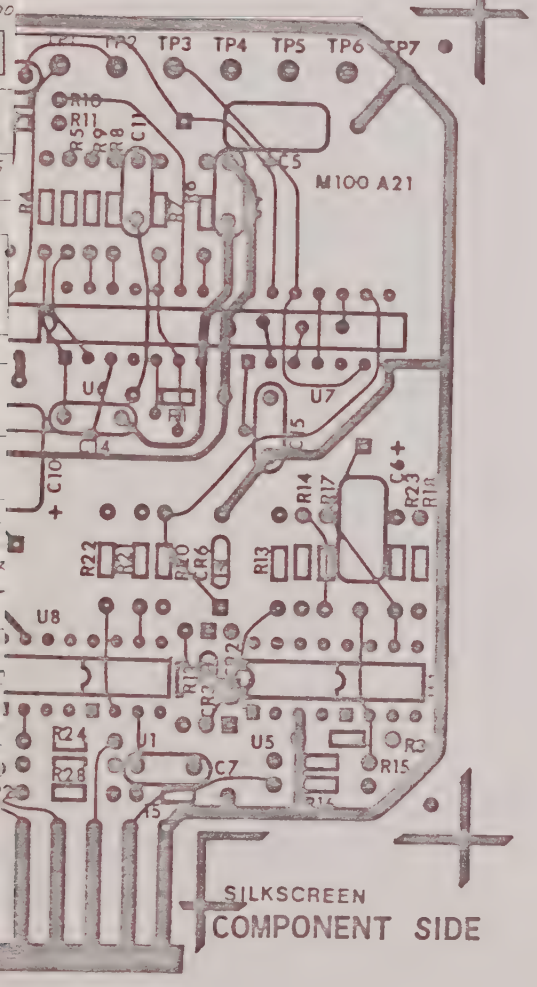
M100A U1 POT TESTER SCHEMATIC
ARI-CONTROL-LESS P.C. BOARD

SIZE C FSCM NO SHEET NO G

PADMASTER - COMP SIDE VIEW



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



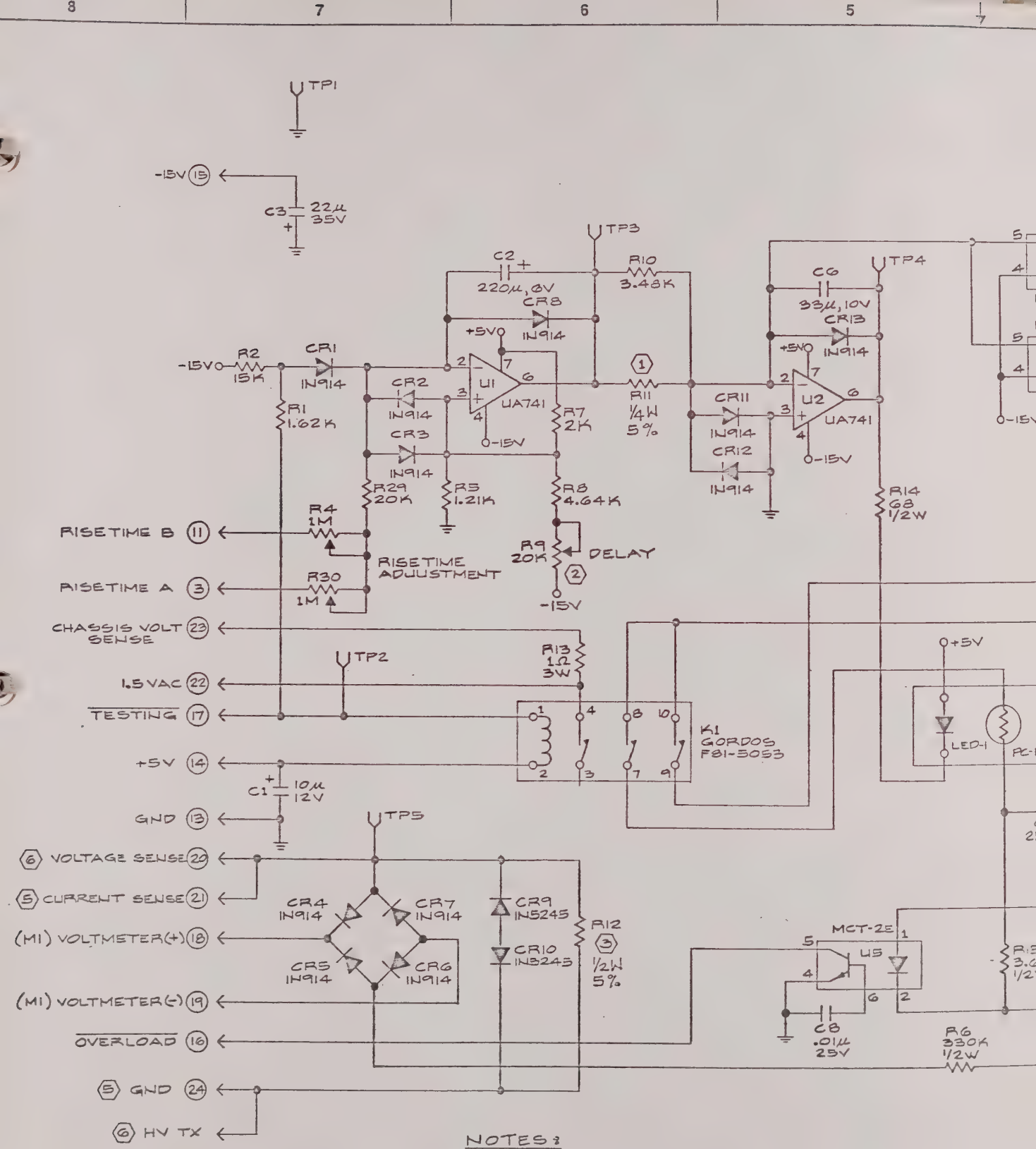
SILKSCREEN
COMPONENT SIDE

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS .XX .XXX ANGLES	CONTRACT NO	ELECTRONICS, INC. 1288 HAMILTON COURT · MENLO PARK, CALIFORNIA 94025 · (415) 322-0727	
	APPROVALS / DRAWN JUN	DATE 8-24-84	A21-CONTROL LOGIC BOARD ASSEMBLY DRAWING
MATERIAL	CHECKED		
FINISH	ISSUED	SIZE C	FSCM NO. DWG NO 00462-02 REV G
NEXT ASSY / USED ON		SCALE 2X	SHEET
APPLICATION	DO NOT SCALE DRAWING		

MATERIAL SPECIFICATION

DWG NO
SH
REV



TABULATION BLOCK	
DASH #	DESCRIPTION
-01	USED ON M100AV/3V
-02	USED ON M500AV/3V

NOTES:

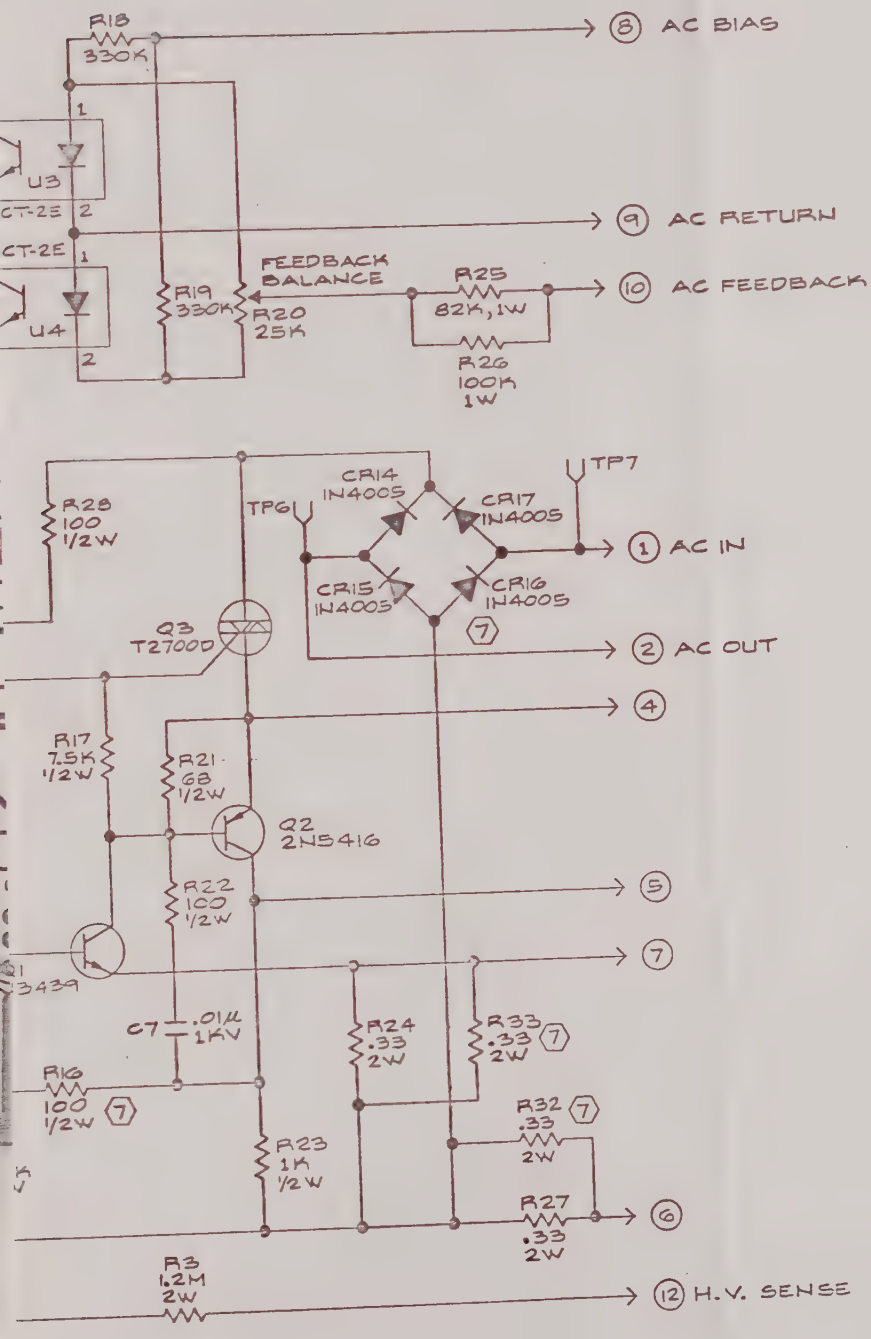
1. SELECT FOR 3V ± .5V AT TP3 WHEN OUTPUT = 95% MAX.
2. SET FOR ≈ 3 SEC DELAY BEFORE START OF RISETIME (30 SE
3. AS PER CUSTOMER REQUIREMENT
4.
5. APPLIES TO 5V MDL ONLY
6. APPLIES TO 3V MDL ONLY
7. APPLIES TO -02 ONLY
   R16 = 200Ω, 1/2W
   CR14-17 = MR754
   ADDED R31 & R32

4	3

DWG. NO.

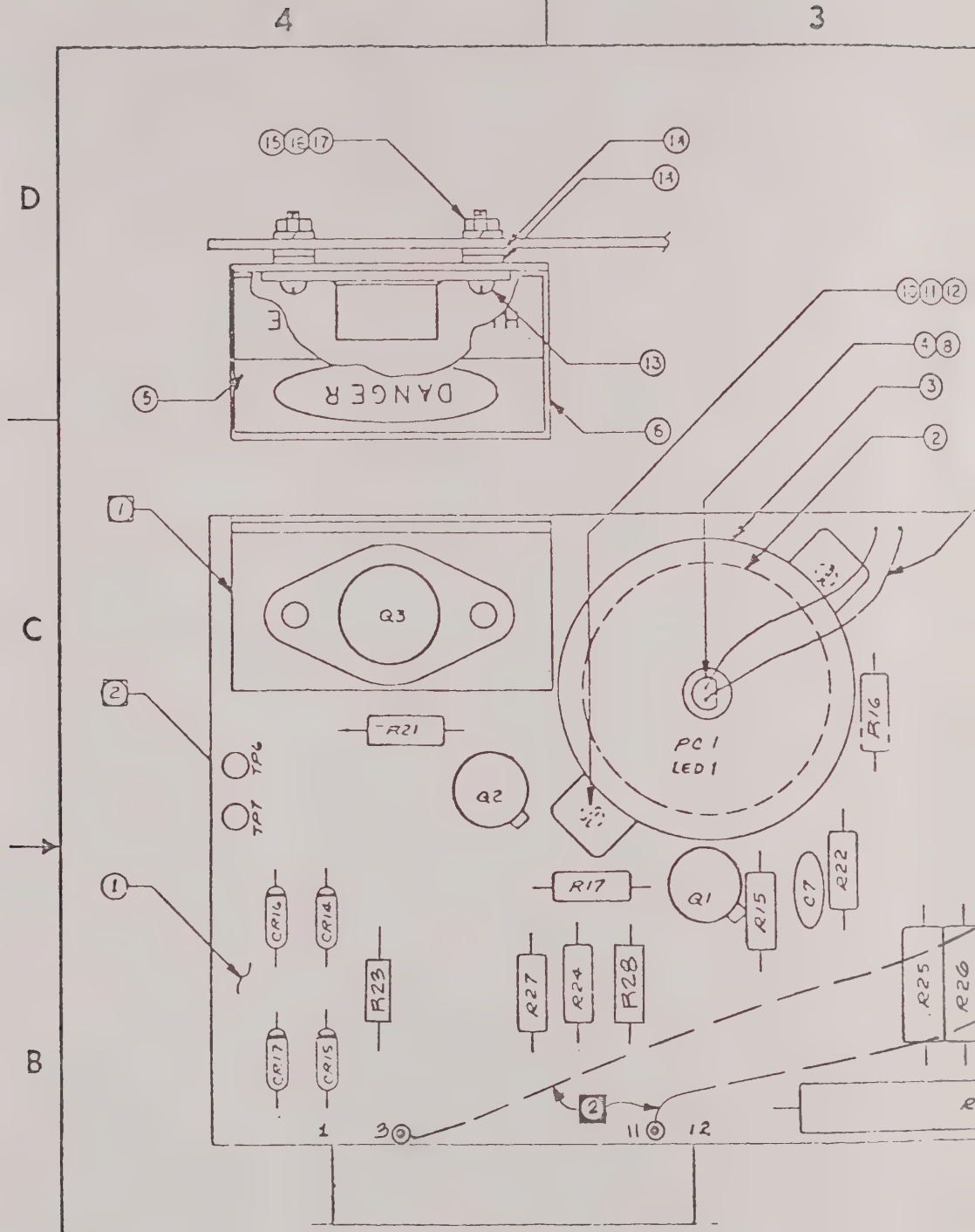
REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	C	DELETED C4 & 5 CHANGED R7	1-86	



RISE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES : XX : : XXX :	CONTRACT NO.	ELECTRONICS, INC.
MATERIAL	APPROVALS / DATE	SCHEMATIC AG-55 AC CONTROL BOARD
C0233-XX AC HIPOT	DRAWN JUN 8-22-8	
	DESIGNED	



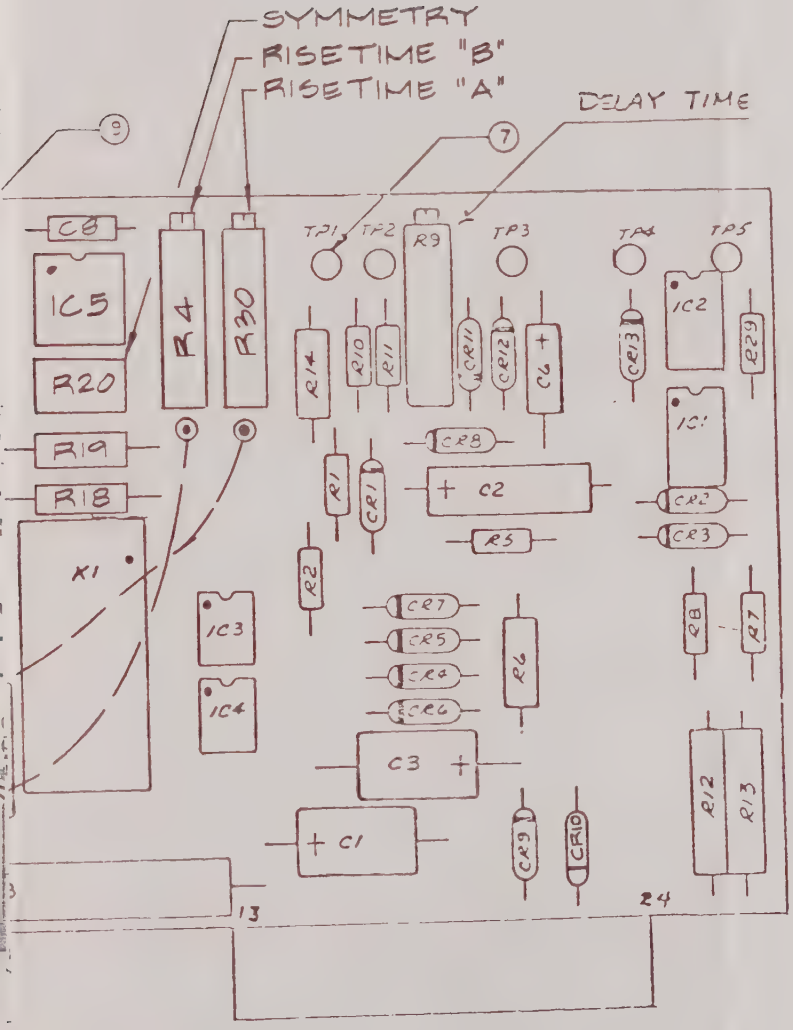
2 INSTALL AND EPOXY FLAT INSULATED WIRE AS SHOWN, ON CKT SIDE

1 APPLY DOW CORNING COMPOUND #340 PER MFGS SPECS.

UNLESS OTHERWISE SPECIFIED.

00237-03	
NEXT ASSY	

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	ADDED R29/RELOCATED R27/DWG # NOW 240	5/27/83	[illegible]
	B	DELETED C4, C5. ADDED C8	8-29-84	RAMON



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL ~

FINISH ~

CONTRACT NO.

APPROVALS	DATE
DRAWN J.K.S. DESIGN	4/29/77
CHECKED	
DESIGNED	
ISSUED	

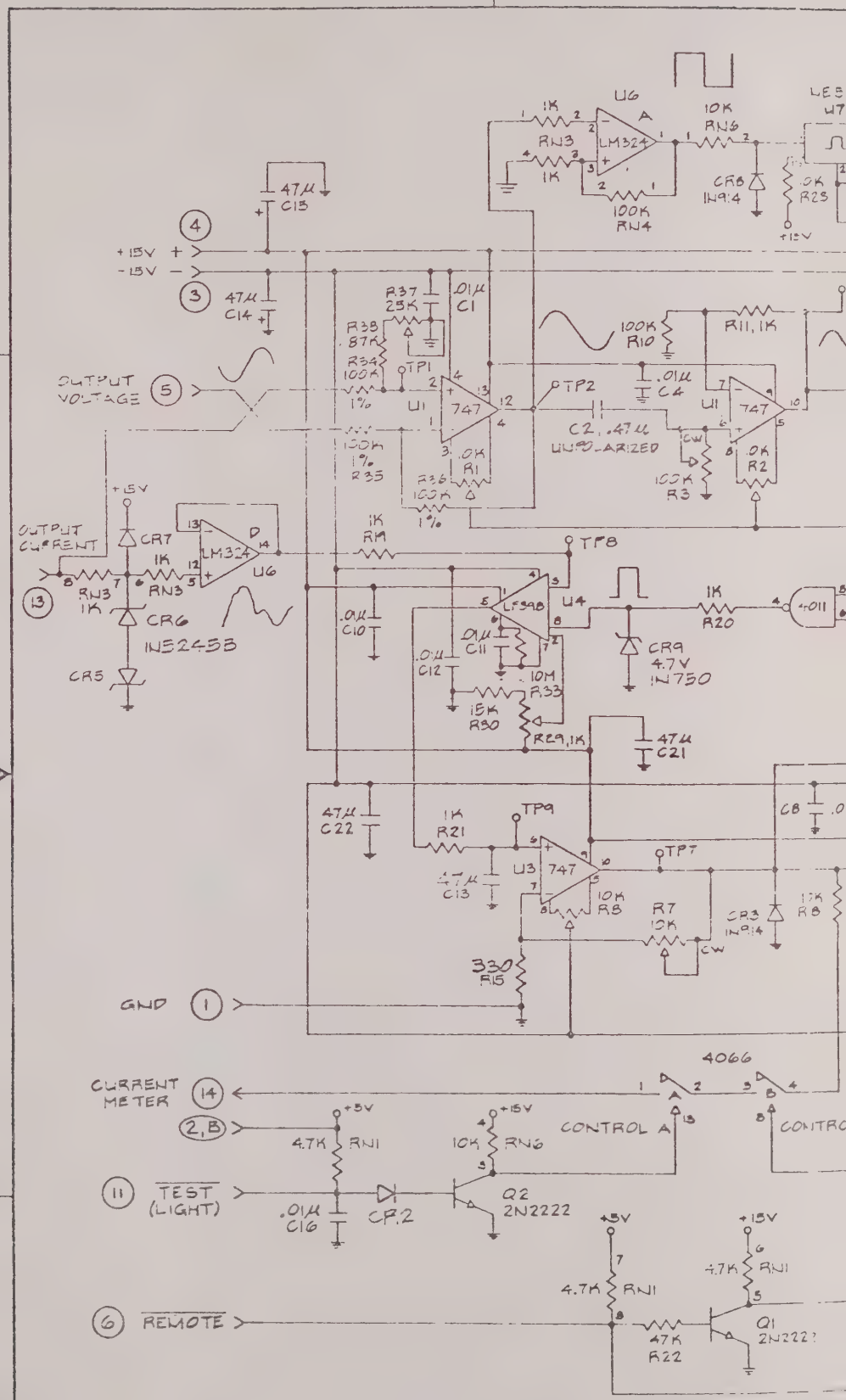
ROD ELECTRONICS, INC.

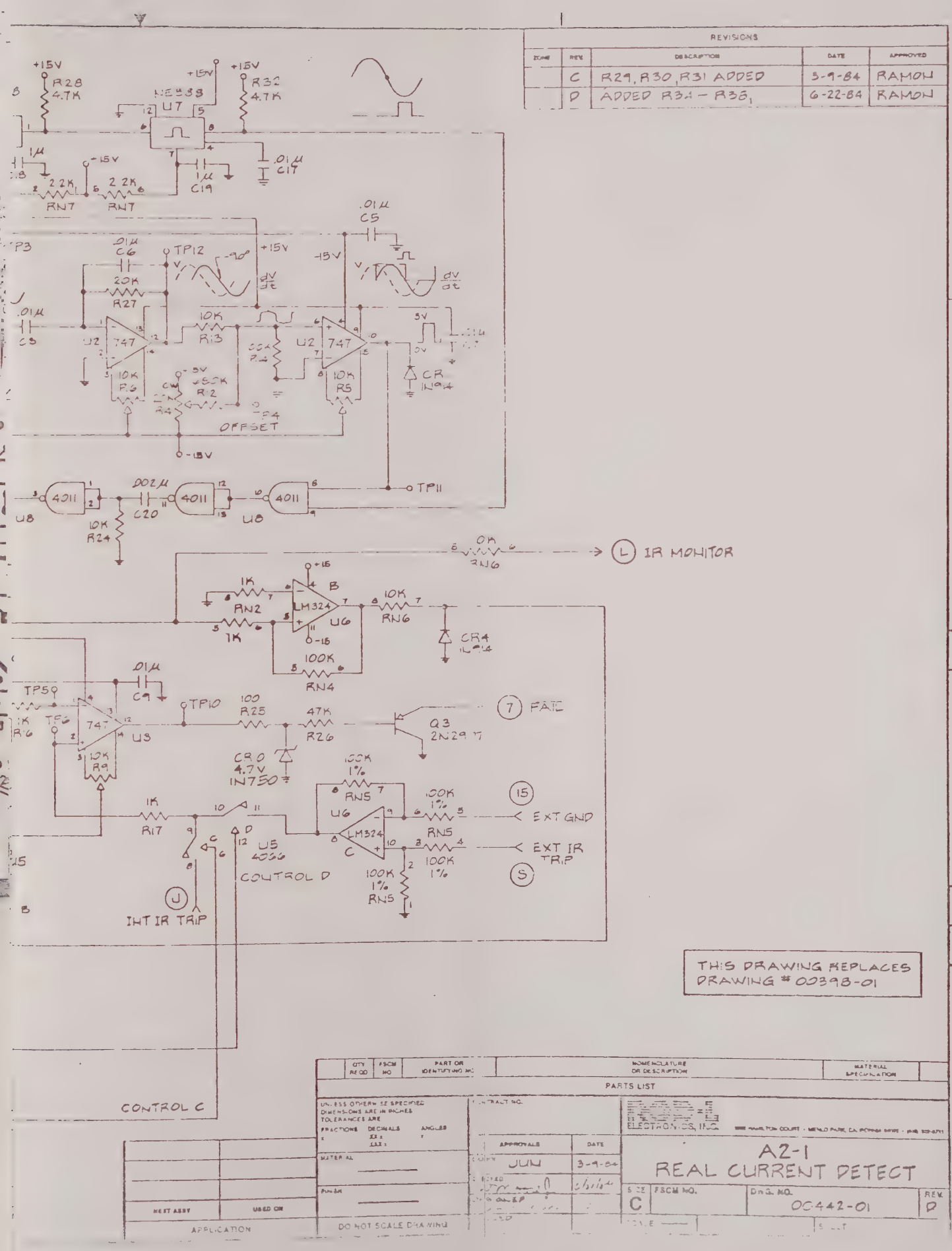
AG-55
A.C. CONTROL BOARD ASSEMBLY DRWG

SIZE	CODE IDENT NO	DRAWING NO.	REV.
C		00238-02	B

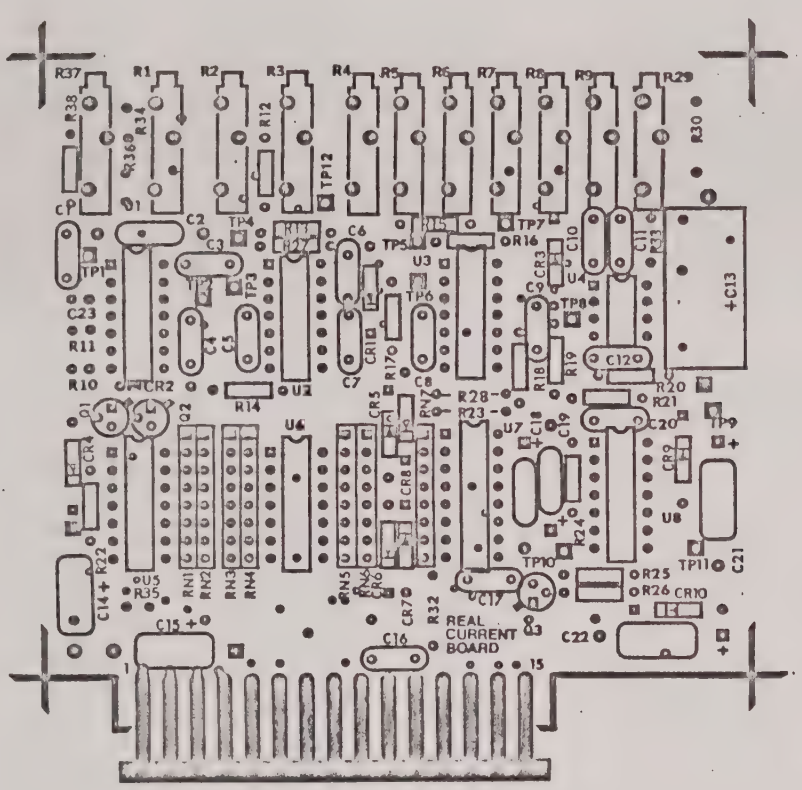
SCALE 3/1

A-55


D
C
B
A
U6
LM324
1K
RN3
1K
10K
RN6
CR8
IN914
100K
RN4
47μ
C15
47μ
C14
+15V
-15V
4
3
5
OUTPUT
VOLTAGE
R37
25K
.01μ
C1
R38
.87K
R34
100K
1%
R35
TP1
U1
747
100K
1%
R36
100K
1%
1.0K
R1
TP2
C2, .47μ
UNPOLARIZED
.01μ
C4
100K
R10
R11, 1K
100K
R3
1.0K
R2
OUTPUT
CURRENT
CR7
1K
RN3
CR6
IN5245B
CR5
13
LM324
U6
1K
RN
TP8
LF398
U4
.01μ
C10
.01μ
C11
.01μ
C12
.10M
R33
15K
R30
R29, 1K
47μ
C21
CR9
4.7V
IN750
1K
R20
47μ
C22
1K
R21
TP9
U3
747
47μ
C13
TP7
10K
R8
R7
10K
CW
CR3
IN914
330
R15
GND
1
4066
CURRENT
METER
14
2,8
4.7K
RN1
+5V
10K
RN6
+15V
CONTROL A
11
TEST
(LIGHT)
.01μ
C16
CR2
Q2
2N2222
6
REMOTE
4.7K
RN1
47K
R22
Q1
2N2222


REVISIONS
ZONE | REV | DESCRIPTION | DATE | APPROVED
C | R29, R30, R31 ADDED | 5-9-84 | RAMON
D | ADDED R34 - R38, | 6-22-84 | RAMON
+15V
R28 4.7K
NE555 U7
R32 4.7K
1µ C18
2.2K RN7
2.2K RN7
1µ C19
.01µ C17
.01µ C5
.01µ C6
TP12
20K R27
.01µ C8
U2 747
10K R13
10K R6
10K R5
5V
.05K R2
OFFSET
CR IN914
TP4
-15V
4011 U8
.002µ C20
10K R24
TP11
0K 2N6
IR MONITOR
1K RN2
LM324 U6
10K RN6
1K
100K RN4
CR4 IN914
.01µ C9
TP9
TP10
100 R25
47K R26
Q3 2N2907
FAIL
CR10 4.7V IN750
.05K 1% RN5
1K R17
U5 4066
CONTROL D
.05K 1% RN5
EXT GND
EXT IR TRIP
100K 1% RN5
INT IR TRIP
CONTROL C
THIS DRAWING REPLACES DRAWING # 00398-01
PARTS LIST
QTY REQD | FSCM NO | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION | MATERIAL SPECIFICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION
DO NOT SCALE DRAWING
APPROVALS | DATE
DRAWN JUN | 3-9-84
CHECKED | 6/11/84
ENG APP
MFG APP
ELECTRONICS, INC.
A2-1
REAL CURRENT DETECT
SIZE C | FSCM NO. | DWG NO. 00442-01 | REV D
SCALE
SHEET

REVISIONS			
ZONE	REV.	DESCRIPTION	DATE
	D	ADDED R34-38	6-22-84



PADMASTER

SILKSCREEN

NOTES:

1. REFERENCE SCHEMATIC DRAWING # 00442-01
2. SEE SEPARATE PARTS LIST

PARTS LIST

QTY REQD	PROD NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± XX ± ± .XXX ±

CONTRACT NO.

APPROVALS	DATE
DRAWN JUN	7-84
CHECKED	
ISSUED	

MATERIAL

FINISH

NEXT ASSY | USED ON

AC HIPOT

APPLICATION

DO NOT SCALE DRAWING

ND-1 ELECTRONICS, INC.

ASSEMBLY
A2-1
REAL CURRENT BOARD

SIZE	FSCM NO.	DWG. NO.
C		00950-01

SCALE 2X

SHEET 1 OF 1

OPTIONS

7-1. A25 P.C. Board: Hands Off/Switch Selectable Failure Points

7-1.1 Description

The A25 P. C. Board contains two options: HANDS OFF and SWITCH SELECTABLE FAILURE POINTS.

The HANDS OFF option requires the operator or remote controller to hold the START line to logic low during the hipot test. If a hipot test is initiated and the START line is found high, or the START button released, a FAIL signal of about one second is produced. The FAIL signal activates both the fail light and the alarm. At the end of the fail indication, the unit is completely RESET if no restart is attempted.

The SWITCH SELECTABLE FAILURE POINTS option provides five extra total current failure points, making a total of six. Each of six failure points are set by individual potentiometers. The option potentiometers are located on a p. c. board on the inside of the front panel, mounted with the switch. The trip point that will be used during a given test is selected by a six-position switch on the front panel.

7-1.2 Theory

The HANDS OFF option consists of a comparator and a set of timers which provide FAILURE, RESET and START signals to the rest of the system.

The start switch is connected to pin 9 of the board. The comparator, U2, inverts and cleans the START signal, putting out a high level when the start switch is held down. The TEST signal is also inverted, giving a high level output when the test is on. The inverted START and TEST signals are fed to the inputs of the monostable multivibrator, U3.

While the TEST signal in the monostable multivibrator, U3, is low, the output through pin 1 is high. If the TEST signal goes high due to a test in progress, U3 is gated to accept triggering from the START signal. If the START signal goes low during a test in progress, U3 will be triggered and a low level pulse of about 100 µS is produced through pin 1, detecting the condition when the start switch is released during a test.

This pulse from pin 1 of U3 triggers one of the two timers in U1 at pin 6. A high level pulse is produced at pin 5 of U1 of about one second, and this creates a FAIL signal of about one second through Q1 and Q2. The FAIL signal activates both the fail light and the alarm. At the end of the fail indication, the unit is completely RESET, and a start can be reattempted.

The start switch is also connected to the second timer through C2, which will produce a high level pulse at pin 9 of U1 on the falling edge of the START signal, that is, when the switch is depressed. This pulse drives Q3, giving a START pulse to the rest of the system.

When this board is combined with the OHMS SENSE option, the START pulse is given by the A24 board instead of the start switch. It must be noted that even when this option is used with the A8 REMOTE CONTROL option, the START signal has to be held low during a test.

The SWITCH SELECTABLE FAILURE POINTS option allows six different trip points to be easily chosen by simply changing the switch position. The five potentiometers on the board with the switch provide five of those trip points, and the sixth potentiometer is the standard set dial on the rear panel.

A decision must be made as to what point a current will be considered too high. That point is the desired trip point, and when the actual current reaches that point, the alarm and fail light will turn on. A potentiometer allows the user to calibrate that trip point, and then select that trip point for use in a test.

The five 100K ohm potentiometers on the A25 option board put out corresponding voltages through pins 6, 8, 10, 12, and 14 to the six-position switch on the front panel. The common of the switch connects to pin J of the A21 Control Logic board. This signal is the TRIP POINT, and is at a voltage level set by the potentiometer which has been selected by the switch. It is compared with the actual current value on the Control PCB.

7-1.3 Installation

This option is factory installed and calibrated. A hole must be carefully drilled in the front panel before assembly, and the switch positions must be properly labeled.

7-2. A24 P.C. Board: Ohms Sense Circuit

7-2.1 Description

The A24 OHMS SENSE option was developed to detect if the Device Under Test (DUT) presents a minimum amount of impedance between the HOT and NEUTRAL leads before a hipot test is actually performed.

Before a hipot test is started, the HOT and NEUTRAL leads are disconnected. The HOT lead, which is normally connected to the HIGH VOLTAGE is momentarily connected to GROUND, and a small voltage of 1.5 VAC RMS is applied to the NEUTRAL lead.

The CHASSIS GROUND SENSE in the A21 Control Logic Board is used to process the voltage across HOT and NEUTRAL leads during this operation. The reference resistance, used normally for the

Ground Sense Test, is also momentarily changed to an adjusted potentiometer to provide tripping for the impedances in the 1500 ohms range. If the READY signal given by the Ground Sense circuitry during the test goes high, we will have an Ohms Sense failure at the end of the Ohms Sense test cycle. This failure operates the alarm in a pulsing mode, and then resets the board.

If the test is passed, the HOT and NEUTRAL are reconnected, the reference resistance for the Ground Sense Test is reconnected, and a START pulse is delivered to the A21 board to start a hipot test.

7-2.2 Theory

When the Hipot Tester is initially turned on, K4 is activated, contacts "A" and "D" of K4 are closed, and K2 is closed. The normal Ground Sense is performed on the A21 Control Logic Board, so the READY lamp is lit. When the START switch is depressed, pins 1, 2, and therefore pin 11 of U2, a NAND gate, go low. U1 is triggered and the output at pin 1 goes high for one second. This one second pulse places a high on pin 1 and 2 of the peripheral driver, U4, causing a low output at pin 3. It deactivates K4, opening contacts "A" and "D," and K2 is opened. It also activates, or closes, K1 and K3. Normal Ground Sense is interupted.

At this time, the 1.5 VAC is applied across the potentiometer, R16. Current flows through R16 and K3 to W3, which is connected to the NEUTRAL of the Device Under Test (DUT.) Current will return from the DUT through the HV RETURN which is tied to the CHASSIS. The HOT wire is momentarily connected to HV RETURN at K1.

One side of R16 is connected to the Chassis Volt Sense, pin 13 of the A21 board. This circuitry senses that the impedance of the DUT is approximately 1/2 of the resistance of R16. If this is not true, a high logic level will appear at A21 pin 10, READY. At the end of the one second pulse, a pulse is produced at pin 8 of U1. If READY is high, the FAIL Latch, U3, will be set. The FAIL Latch is set, U5, a timer, will be triggered and give out pulses to sound the alarm. The FAIL output at Q2 is connected back to the RESET circuitry so that any kind of failure can reset the board.

If the resistance of the DUT is equal to or less than 1500 ohms, the negative edge of a pulse generated at pin 8 of U1 will trigger U1, pin 11. A one second pulse at U1, pin 9 is generated to allow the normal Ground Sense Circuitry to settle down. When the one second pulse at U1 ends, K4 and K2 are activated and K1 and K3 opened.

The trailing edge of the one second pulse at U1 pin 9 triggers a 20 mS pulse at U1 pin 16 which will start the normal cycle of the Hipot Tester.

R15 is used to adjust the timing of the FAIL pulsing signal.

7-2.3 Installation

This option is factory installed and calibrated.

7-3. A8 P.C. Board: Automatic Reset/Digital Remote Control

7-3.1 Description

The Model A8 P. C. Board contains two options: AUTOMATIC RESET and DIGITAL REMOTE CONTROL.

The AUTOMATIC RESET option generates a short duration FAIL and RESET pulse after a failure is latched in the A21 Control Logic Board. At the end of the FAIL pulse the system is completely reset if no restart is attempted.

The DIGITAL REMOTE CONTROL option provides optically isolated control and monitoring of the main functions of the unit. The inputs are START, RESET, and SELECT "A." The outputs are READY, TEST, and FAIL (ALARM.)

There are two revision level boards; D and F. Revision D provides high active current driven inputs at 25 mA and low active TTL outputs. Revision F provides low active TTL inputs and low active TTL outputs.

7-3.2 Theory

AUTOMATIC RESET OPTION

During a TEST, if there is a FAIL, it produces a one shot negative pulse in the retriggerable monostable multivibrator, U4. The falling edge produces a one shot pulse in the timer, U5. This pulse drives Q2, which drives the alarm through pin B of the board, and also drives a NAND Gate, OC, U1, which resets the system through pin 5 of the board. At the end of the pulse from U5, the system is RESET and the alarm is off. U1 will also RESET the system when REMOTE RESET is produced. If this option is not needed, A, B, C, and D jumpers are placed so that the FAIL signal drives the alarm as normal, and the REMOTE RESET goes directly to the RESET line.

OPTICALLY ISOLATED CONTROL

This provides three inputs: START, RESET, and SELECT "A," and three outputs: READY, TEST, and FAIL (ALARM.)

The input current requirements are:

REV F:		REV D:	
HIGH LEVEL:	40µA @ +5V	HIGH LEVEL:	18mA @ +5V
LOW LEVEL:	1.6mA @ 0.4V	LOW LEVEL:	0mA

The output current capabilities are:

HIGH LEVEL:	2.27mA @ +5V
LOW LEVEL:	2.27mA max @ +5V

When the optical coupler, U3, is driven, a RESET signal is produced at pin 5 of the board, either directly through the C to D jump or through U1 when the AUTOMATIC RESET option is installed.

When the optical coupler, U2, is driven, a START signal goes out through pin 9 of the board.

When the optical coupler, U9, is driven, the voltage at pin 5 of U9 is low, and Q1 does not drive the relay, K1. This connection is called STAND BY, and the A RISE and TEST TIMEs are selected. If U9 is not driven, pin 5 of U9 goes high and Q1 drives the relay, so that the B RISE and TEST TIMEs are selected.

When the GROUND TEST signal through pin 10 is low, U6, an optical coupler is activated, and a low level is available on the REMOTE connector through pin L of the board.

When a TEST is in progress, the TEST line, pin 11, is low. The optical coupler, U7, is activated and a low level is available on the REMOTE connector through pin M of the board.

The FAIL signal activates the optical coupler, U8, either from pin 12, or pin B when the AUTOMATIC RESET option is used. It provides a low level on the REMOTE connector through pin N of the board.

The remote controller's +5V and GND are fed through pins K and 15 respectively.

REMOTE CONTROL OPTION DB25 CONNECTOR PIN ASSIGNMENT

1	GND (external)	21	READY*
4	GND (chassis)	22	TEST*
18	RESET	23	FAIL*
19	START	25	SELECT A
20	+5V (remote)		

7-3.3 Installation

This option is factory installed and calibrated.

ASSEMBLY DESCRIPTION: A25 HANDS-OFF/CURRENT FAIL GND TESTER AV/BV P. C. BOA
ASSEMBLY NUMBER: 00433-02 REV. C

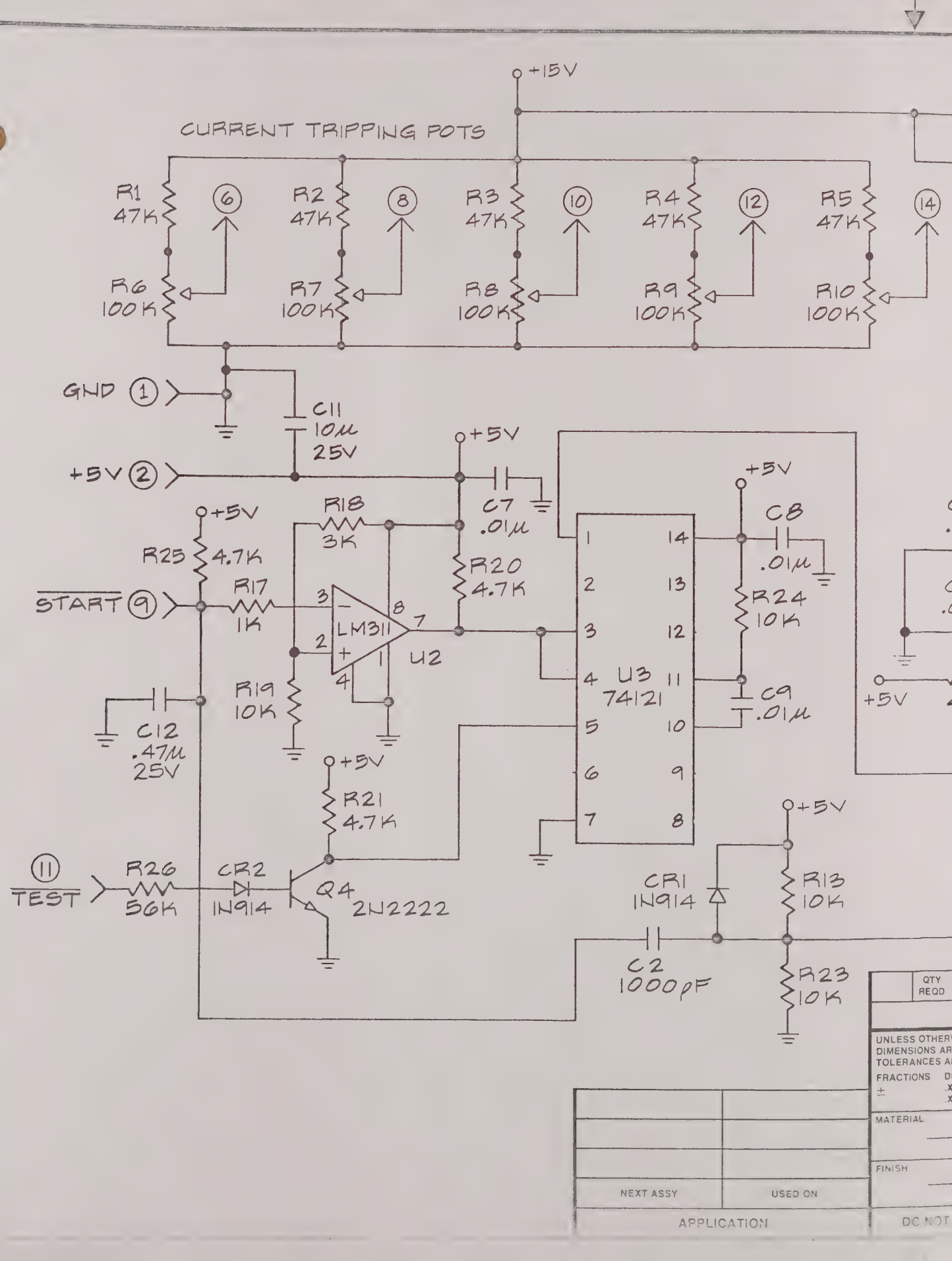
P/N	DESCRIPTION	REFERENCE	QTY
00433-03	PCB, RAW	A25	1
50323-03	CAPACITOR, DISC .001µF 100V	C2	1
50323-02	CAPACITOR, DISC .01µF 100V	C3-9	7
50061-03	CAPACITOR, FILM .1µF 80V	C1	1
50066-07	CAPACITOR, MONOLYTHIC .47µF 50V	C12	1
50324-05	CAP., ELECTROLYTIC 10µF 25V	C10,11	2
50125-31	RESISTOR, CC 1k OHM ¼W 5%	R17	1
50125-38	RESISTOR, CC 3k OHM ¼W 5%	R18	1
50125-40	RESISTOR, CC 4.7k OHM ¼W 5%	R14-16,20-22,25	7
50125-44	RESISTOR, CC 10k OHM ¼W 5%	R13,19,23,24	4
50125-53	RESISTOR, CC 47k OHM ¼W 5%	R1-5	5
50125-55	RESISTOR, CC 56k OHM ¼W 5%	R26	1
50025-61	RESISTOR, CC 10m OHM ¼W 5%	R11,12	2
50702-11	POTENTIOMETER, 100k 20 TURN 3006P-1-104 BOURNS	R6-10	5
50036-01	DIODE, SIGNAL 1N914	CR1,2	2
50267-01	TRANSISTOR, NPN SSMTL 2N2222	Q1-4	4
50127-01	IC, VOLT COMPARATOR LM311	U2	1
50092-01	IC, DUAL TIMER NE556	U1	1
50139-01	IC, MONSTBL MULTVBRTR RETRIGERABLE SN74121	U3	1
50264-08	SOCKET, IC 8 PIN LOPROFILE CDH-4000-08-B SAE	U2	1
50264-14	SOCKET, IC 14 PIN LOPROFILE CDH-4000-14-B SAE	U1,3	2

ASSEMBLY DESCRIPTION: A24 OHM SENSE AV/BV P. C. BOARD
ASSEMBLY NUMBER: 00434-02 REV. FOR IBM

P/N	DESCRIPTION	REFERENCE	QTY
00434-03	PCB, RAW	A24	1
50323-03	CAPACITOR, DISC .001µF 100V	C7	1
50323-02	CAPACITOR, DISC .01µF 100V	C3-6,8,9,11,12, 15,17,18	11
50061-03	CAPACITOR, FILM .1µF 80V	C14	1
50318-01	CAPACITOR, MYLAR .33µF 100V	C2,16	2
50066-07	CAPACITOR, MONOLYTHIC .47µF 25V	C10	1
50324-05	CAP., ELECTROLYTIC 10µF 25V	C1	1
50125-40	RESISTOR, CC 4.7k OHM ¼W 5%	R1,9,10,14	5
50125-44	RESISTOR, CC 10k OHM ¼W 5%	R3-5,8,12,17	6
50125-59	RESISTOR, CC 100k OHM ¼W 5%	R7	1
50125-74	RESISTOR, CC 680k OHM ¼W 5%	R2	1
50126-01	RESISTOR, CC 1m OHM ¼W 5%	R6,11	2
50126-07	RESISTOR, CC 4.7m OHM ¼W 5%	R13	5
50702-06	POTENTIOMETER, 5k 20 TURN 3006P-1-502 BOURNS	R16	1
50702-12	POTENTIOMETER, 1m 20 TURN 3006P-1-105 BOURNS	R15	1
50034-01	DIODE, 600V 1A RCTFIR 1N4005	CR1-4	4
50267-01	TRANSISTOR, NPN SSMTL 2N2222	Q1,2	2
50091-01	IC, TIMER NE555	U5	1
50093-01	IC, QUAD TIMER NE558	U1	1
50135-01	IC, QUAD 2IN NAND SN7400	U2,3	2
50167-01	IC, DUAL PERPHL DRIVR SN75452P	U4	1
50264-08	SOCKET, IC 8 PIN LOPROFILE CDH-4000-08-B SAE	U4,5	2
50264-14	SOCKET, IC 14 PIN LOPROFILE CDH-4000-14-B SAE	U2,3	2
50264-16	SOCKET, IC 16 PIN LOPROFILE CDH-4000-16-B SAE	U1	1
50222-08	HEADER CENTERLINE HLSS100-8 PANDUIT	P1,2	2
50151-01	PIN, TEST 1405-3 KEYSTONE	TP1-4	4
50570-01	RELAY, DPDT 12VDC HP11D POTTR&BRMFLD	K4	1
50293-01	RELAY 378992 DOUG RAND	K1-3	3
C13 NOT USED ON DRAWING			
* OPTIONAL FOR OHM SENSE TESTER INSTRUMENT			
50125-40	RESISTOR, CC 4.7k OHM ¼W 5%	R18*	1
50034-01	DIODE, 600V 1A RCTFIR 1N4005	CR5*	1
50267-01	TRANSISTOR, NPN SSMTL 2N2222	Q3*	1

ASSEMBLY DESCRIPTION: A8 REMOTE CONTROL LOGIC W/ AUTO-RESET GND TEST, AV/BV
ASSEMBLY NUMBER: 00445-02 REV. G

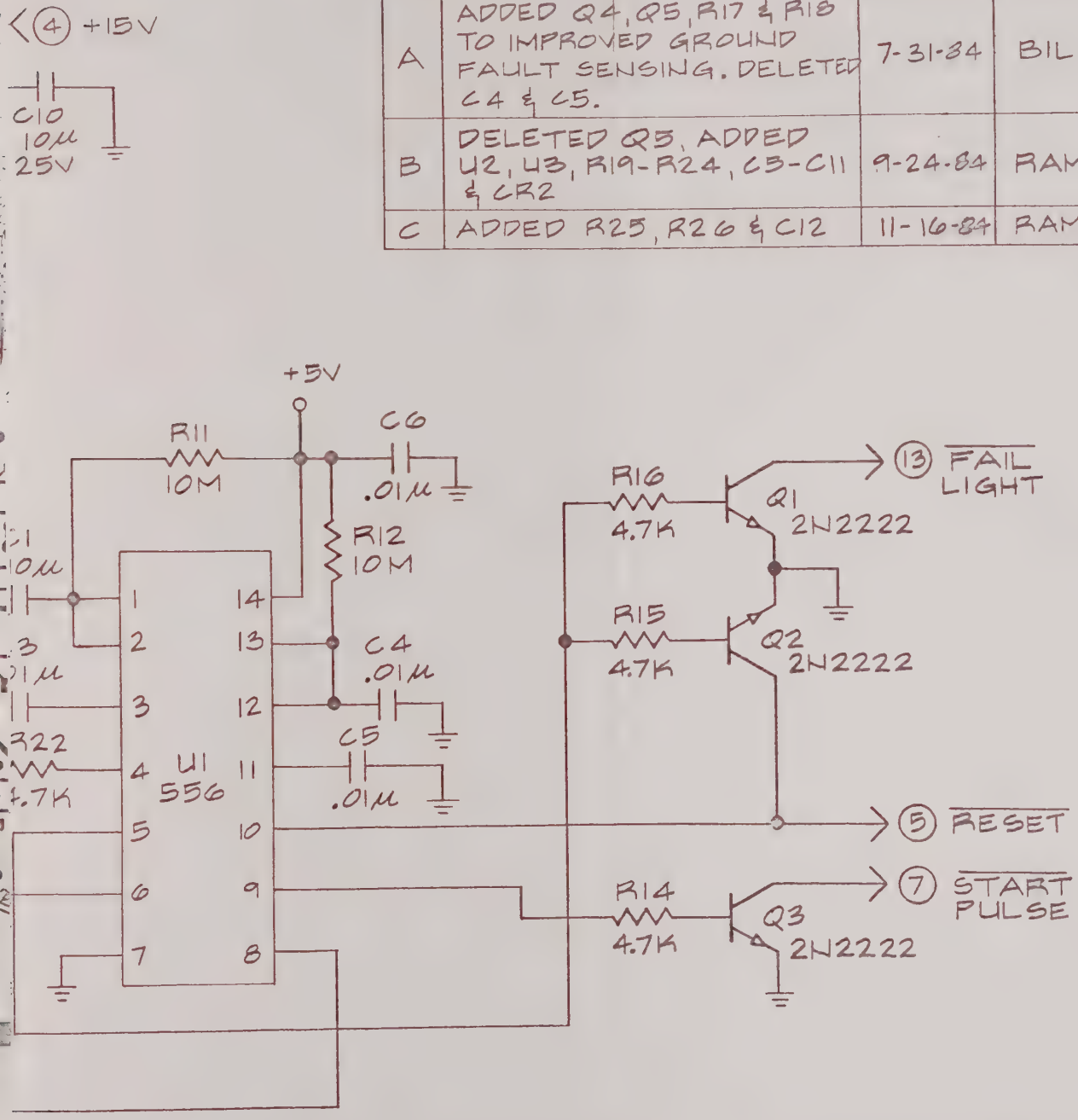
P/N	DESCRIPTION	REFERENCE	QTY
00445-03	PCB, RAW	A8	1
50324-05	CAP., ELECTROLYTIC 10µF 25V	C1,2	2
50125-21	RESISTOR, CC 330 OHM ¼W 5%	R4*,5,6	3
50125-31	RESISTOR, CC 1k OHM ¼W 5%	R7*	1
50125-35	RESISTOR, CC 2k OHM ¼W 5%	R1-3	3
50125-36	RESISTOR, CC 2.2k OHM ¼W 5%	R11*	1
50125-59	RESISTOR, CC 100k OHM ¼W 5%	R8-10	3
50267-01	TRANSISTOR, NPN SSMTL 2N2222	Q1*	1
50095-01	IC, HEX INVTR DRVR OC SN7416	U10	1
50141-01	IC, HEX BFFR DRVR, OC SN7417	IBM OPTION:	
50079-01	IC, OPTICAL COUPLER H11B1 OR H11B3	U2,3,6-8,9*	6
50264-06	SOCKET, IC 6 PIN LOPROFILE CDH-4000-06-B SAE	U2,3,6-8,9*	6
50264-08	SOCKET, IC 8 PIN LOPROFILE CDH-4000-08-B SAE	U5*	1
50264-14	SOCKET, IC 14 PIN LOPROFILE CDH-4000-14-B SAE	U10	1
50571-01	RELAY, DPDT5V 1495SDC A410-367021-30	K1*[3]	1
* DELETE THESE AND ITEMS 15-33 FOR OHM SENSE TESTER UNIT ONLY			
[1] ADD FOR AUTO RESET:			
50323-02	CAPACITOR, DISC .01µF 100V	C5[1],6[1],7[1]	3
50060-12	CAPACITOR, TANTALUM .1µF 20V	C3[1]	1
	CAPACITOR, TANTALUM 6.8µF 10V	C4[1]	1
50125-31	RESISTOR, CC 1k OHM ¼W 5%	R12[1]	1
50125-40	RESISTOR, CC 4.7k OHM ¼W 5%	R13[1],17[1]-22[1],	7
50125-79	RESISTOR, CC 20k OHM ¼W 5%	R14[1]	1
50125-69	RESISTOR, CC 330k OHM ¼W 5%	R15[1]	1
50702-12	POTENTIOMETER, 1m 20 TURN 3006P-1-105 BOURNS	R16[1]	1
50036-01	DIODE, SIGNAL 1N914B	CR1[1]	1
50267-01	TRANSISTOR, NPN SSMTL 2N2222	Q2[1]	1
50091-01	IC, TIMER NE555	U5[1]	1
50137-01	IC, QUAD 2IN NAND, OC SN7403	U1[1]	1
50140-01	IC, MONSTBL MULTVBRTR RETRIGERABLE SN74122	U4[1]	1
50264-14	SOCKET, IC 14 PIN LOPROFILE CDH-4000-14-B SAE	U1[1],4[1]	2
[2] ADD FOR MONITORING			
50125-44	RESISTOR, CC 10k OHM ¼W 5%	R23[2],24[2],27[2],29[2]	4
50702-07	POTENTIOMETER, 10k 20 TURN 3006P-1-103 BOURNS	R25[2]	1
	POTENTIOMETER, 50k 20 TURN 3006P-1-503 BOURNS	R26[2],28[2]	2
50103-01	IC, DUAL OP AMP UA747CN	U11[2]	1
50264-14	SOCKET, IC 14 PIN LOPROFILE CDH-4000-14-B SAE	U11[2]	1
[3] M25 USES MONITORING INSTEAD OF K1			


+15V
CURRENT TRIPPING POTS
R1 47K
R2 47K
R3 47K
R4 47K
R5 47K
R6 100K
R7 100K
R8 100K
R9 100K
R10 100K
6
8
10
12
14
GND 1
+5V 2
C11 10μ 25V
+5V
C7 .01μ
+5V
C8 .01μ
R18 3K
R25 4.7K
R17 1K
START 9
LM311
U2
R20 4.7K
R24 10K
U3 74121
C9 .01μ
+5V
R19 10K
C12 .47μ 25V
+5V
R21 4.7K
11
TEST
R26 56K
CR2 IN914
Q4 2N2222
CR1 IN914
+5V
R13 10K
C2 1000pF
R23 10K
QTY REQD
UNLESS OTHER
DIMENSIONS AR
TOLERANCES A
FRACTIONS
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION
DO NOT

DWG. NO.	SH	REV.

REVISIONS

REV.	DESCRIPTION	DATE	APPROVED
A	ADDED Q4, Q5, R17 & R18 TO IMPROVED GROUND FAULT SENSING. DELETED C4 & C5.	7-31-84	BILL
B	DELETED Q5, ADDED U2, U3, R19-R24, C5-C11 & CR2	9-24-84	RAMON
C	ADDED R25, R26 & C12	11-16-84	RAMON



FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

VISE SPECIFIED
E IN INCHES
IE:
CIMALS ANGLES
X ± ±
XX ±

CONTRACT NO.

APPROVALS	DATE
DRAWN JUN	3-6-84
CHECKED	
ISSUED	

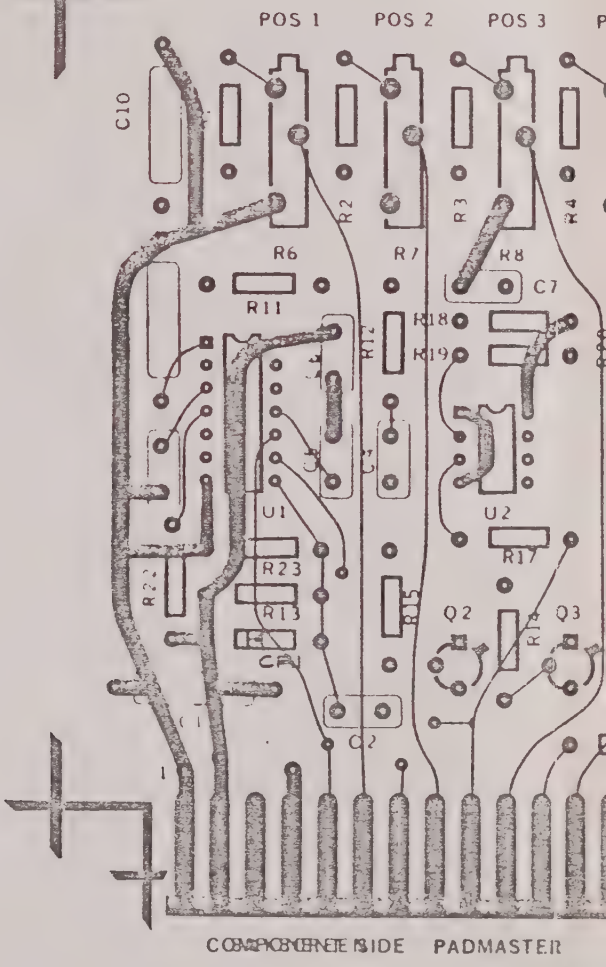
SCALE DRAWING

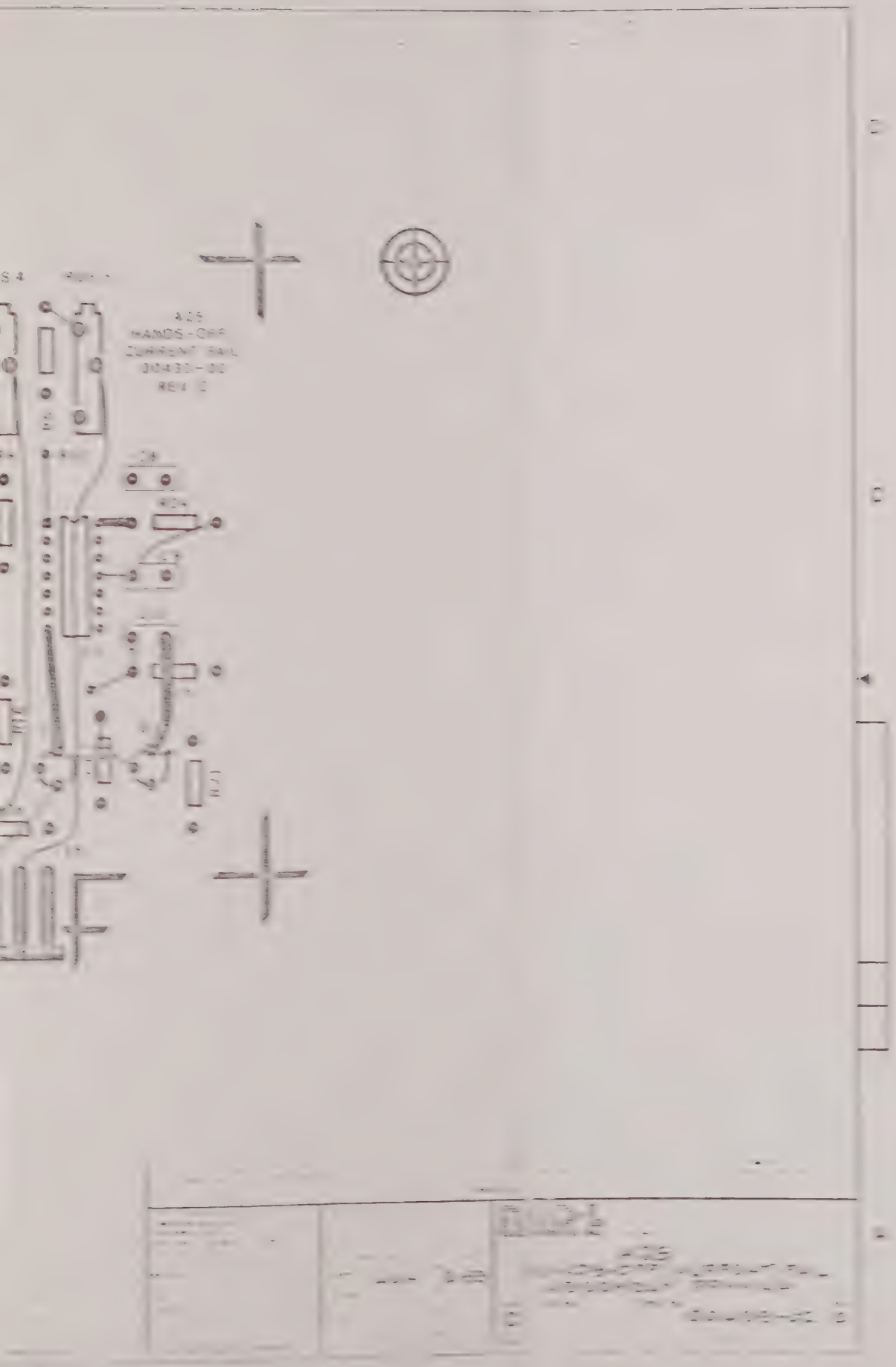
ELECTRONICS, INC. 1098 HAMILTON COURT • MENLO PARK, CALIFORNIA 94025 • (415) 322-0711

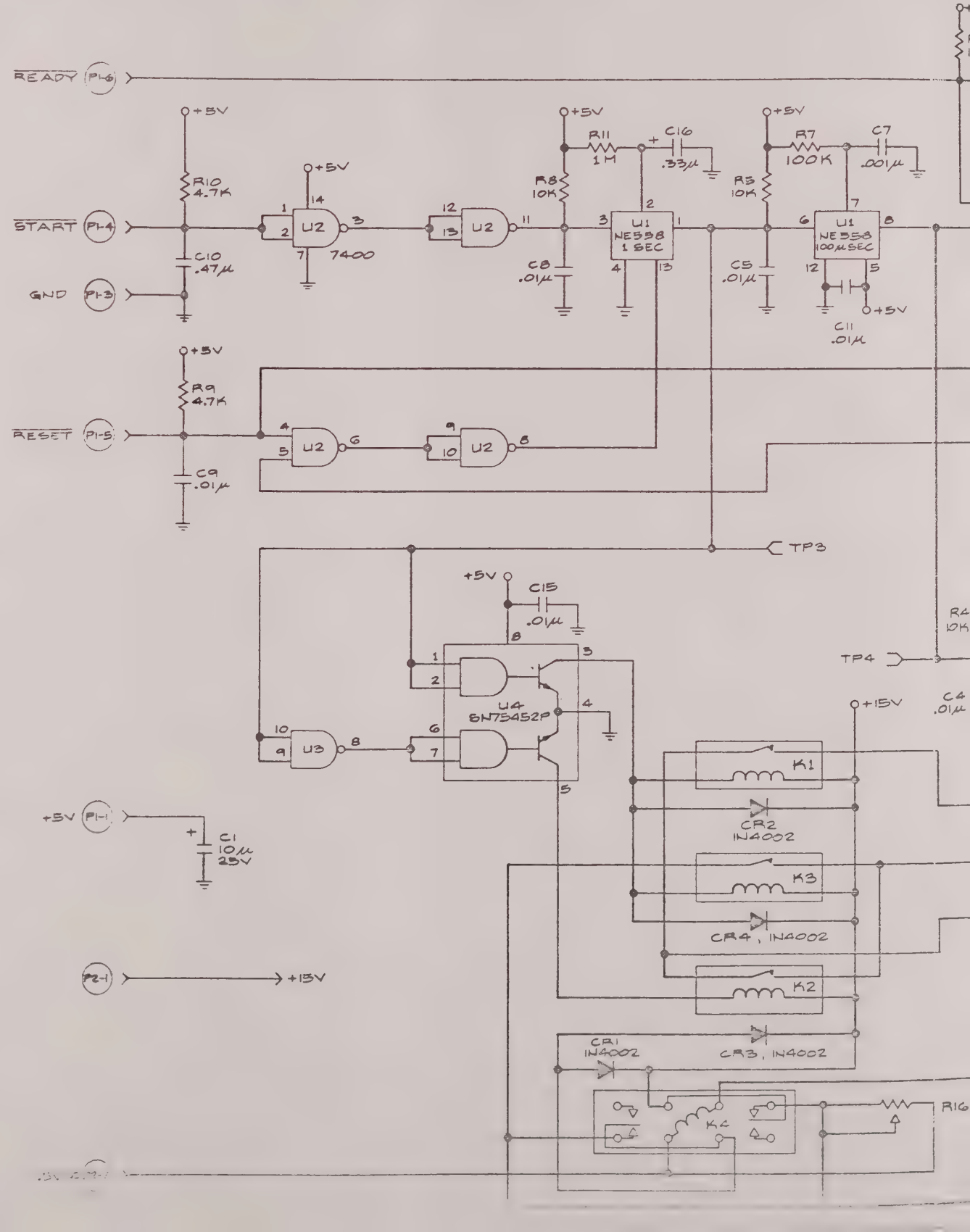
A25
HANDS-OFF/CURRENT FAIL

SIZE	FSCM NO.	DWG. NO.	REV.
B		00433-01	C

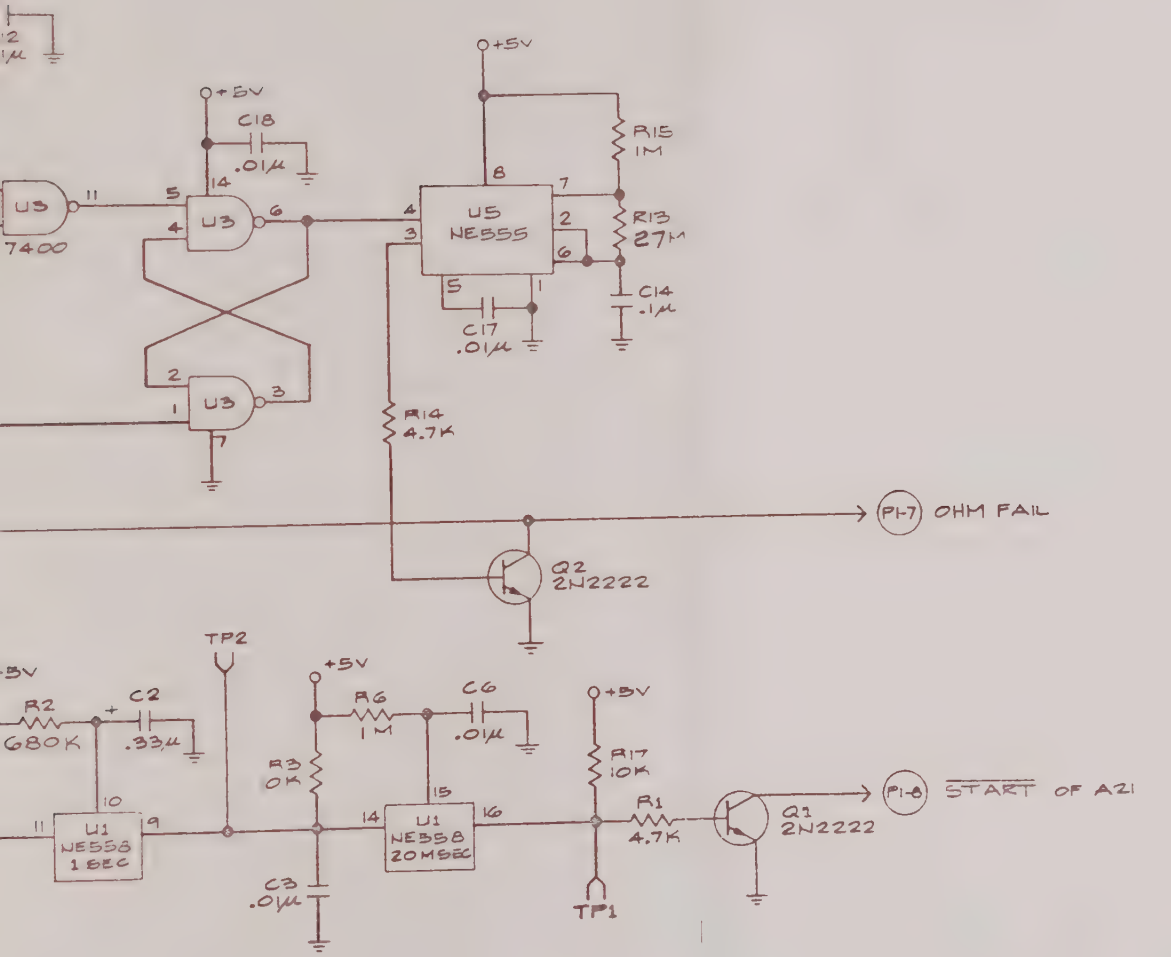
SCALE —— SHEET


POS 1
POS 2
POS 3
C10
R2
R3
R4
R6
R7
R8
C7
R11
R18
R19
U1
U2
R17
R23
R13
Q2
Q3
C2
COMPONENT SIDE
PADMASTER


A25
HANDS-OFF
CURRENT RAIL
30430-30
REV C


READY
P1-6
+5V
R10
4.7K
START
P1-4
C10
.47μ
GND
P1-3
U2
7400
R8
10K
C8
.01μ
R11
1M
C16
.33μ
U1
NE558
1 SEC
R3
10K
C5
.01μ
R7
100K
C7
.001μ
U1
NE558
100μSEC
C11
.01μ
R9
4.7K
RESET
P1-5
C9
.01μ
TP3
C15
.01μ
U4
SN75452P
U3
TP4
+15V
C4
.01μ
K1
CR2
IN4002
K3
CR4, IN4002
K2
CR1
IN4002
CR3, IN4002
K4
P2-1
+15V
C1
10μ
25V

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	C	DELETED C19, TRACE BET. U2-5 & U3-3. ADDED TRACE BET. U2-5 & Q2. C10 RATING	8-20-84	RAMON



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

MATERIAL

FINISH

CONTRACT NO

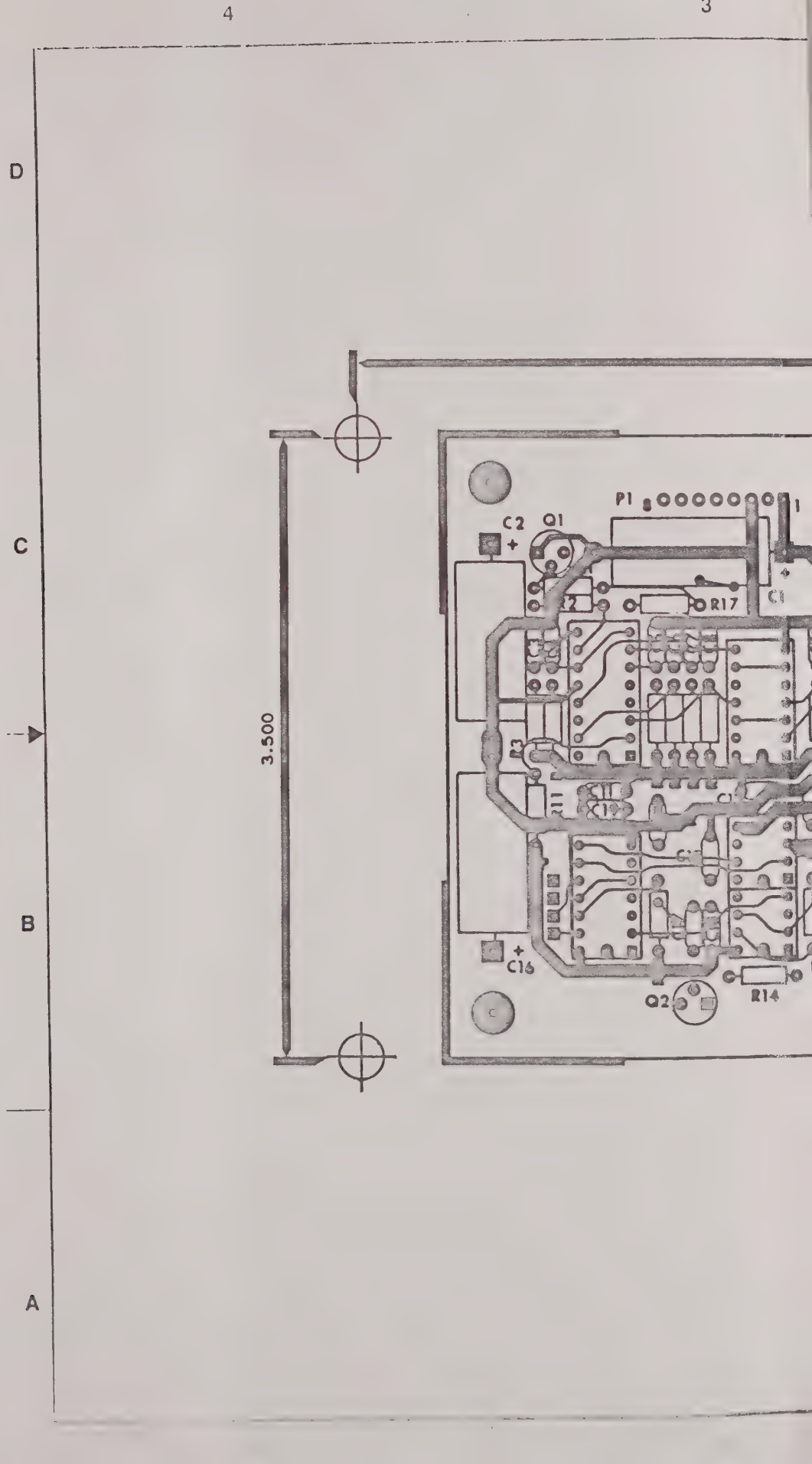
APPROVALS	DATE
DRAWN JUN	3-7-84
DESIGNED	
CHECKED	

ELECTRONICS, INC. 1020 MARSTON COURT · MENLO PARK, CALIFORNIA 94025 · (415) 328-6711

SCHEMATIC
OHM SENSE BOARD

C0434-02	AC HIPOT
NEXT ASSY	USED ON

SIZE D | FSCM NO | DWG NO 00434-01 | REV C


4
3
D
C
B
A
3.500
P1
C2
Q1
R17
C1
C16
Q2
R14

2 1

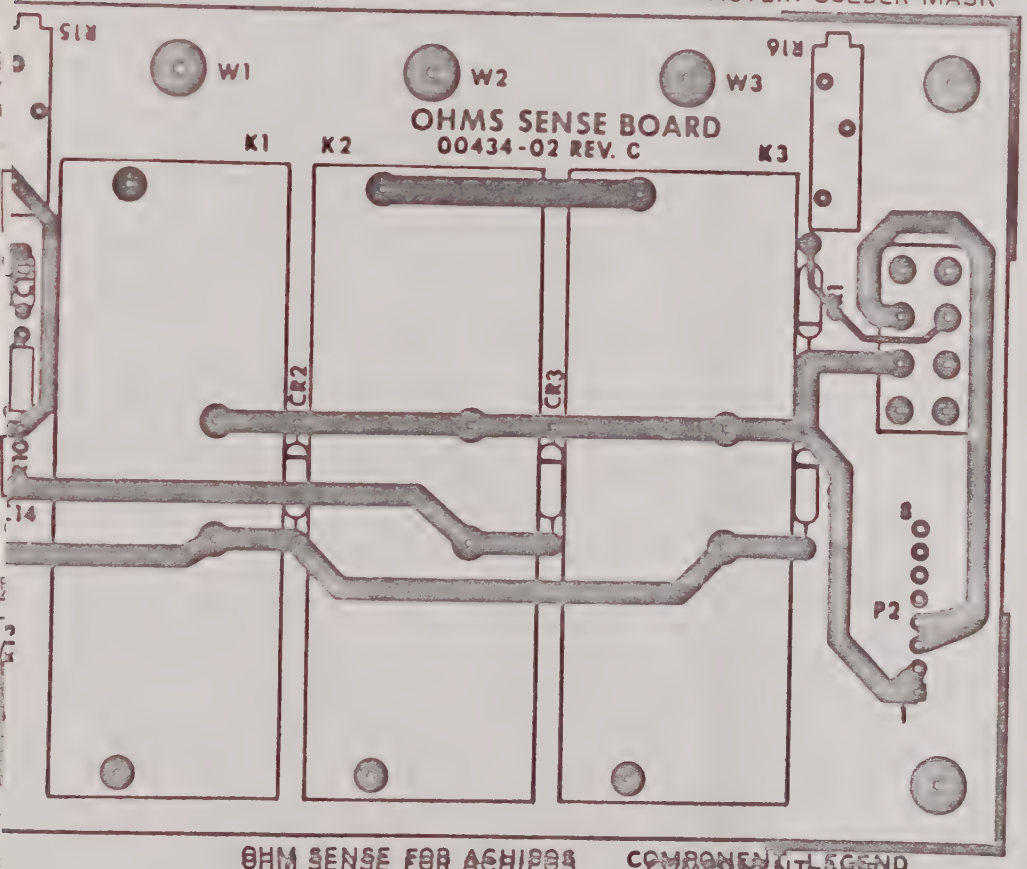
REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

D C A

7.500

OHM SENSE FOR ACHIPOS PAD MASTER / SOLDER MASK



OHM SENSE FOR ACHIPOS COMPONENT SIDE

COMPONENT SIDE

PARTS LIST

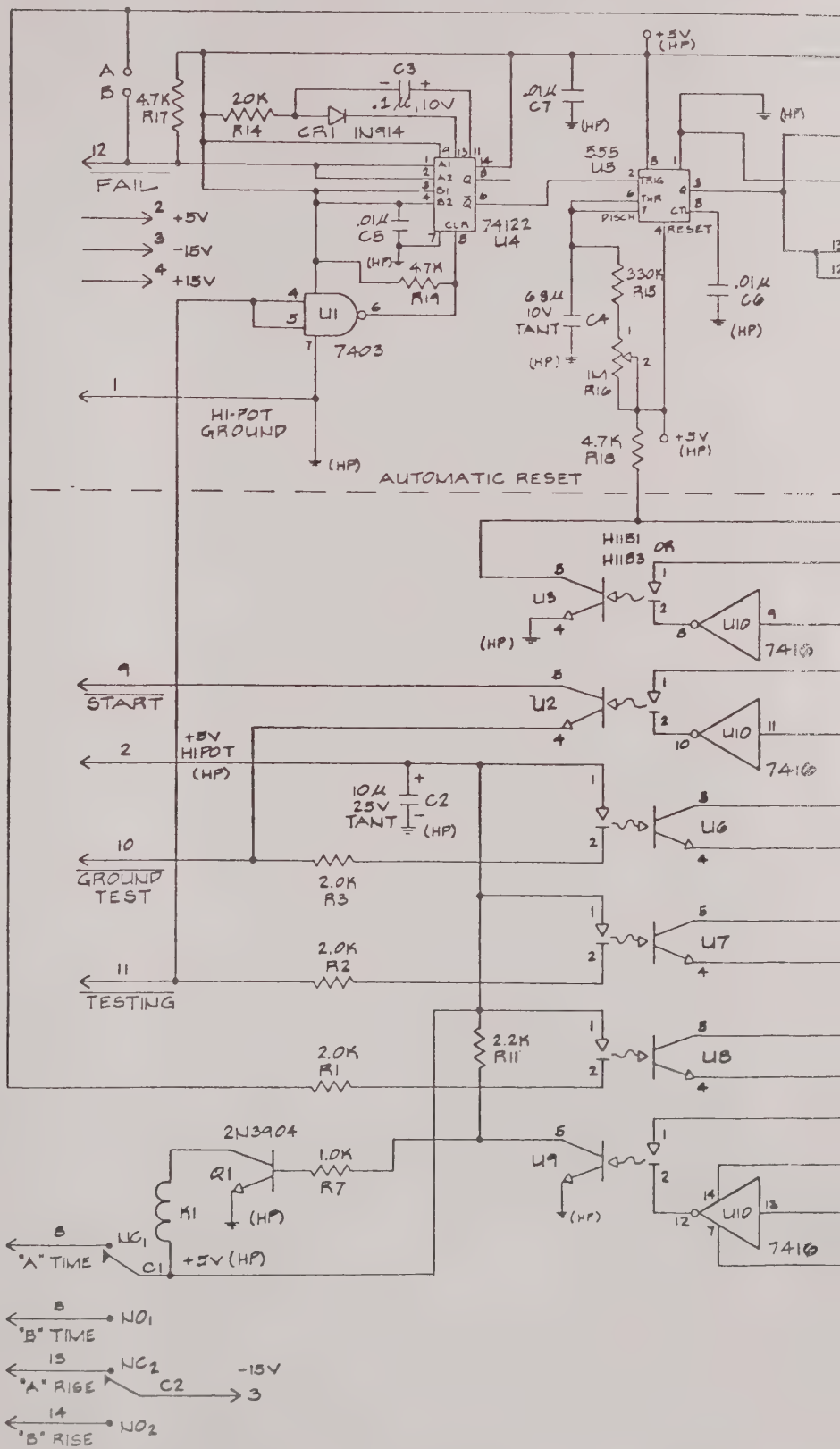
DRAWN	JUH	10-84	
APPROVED			

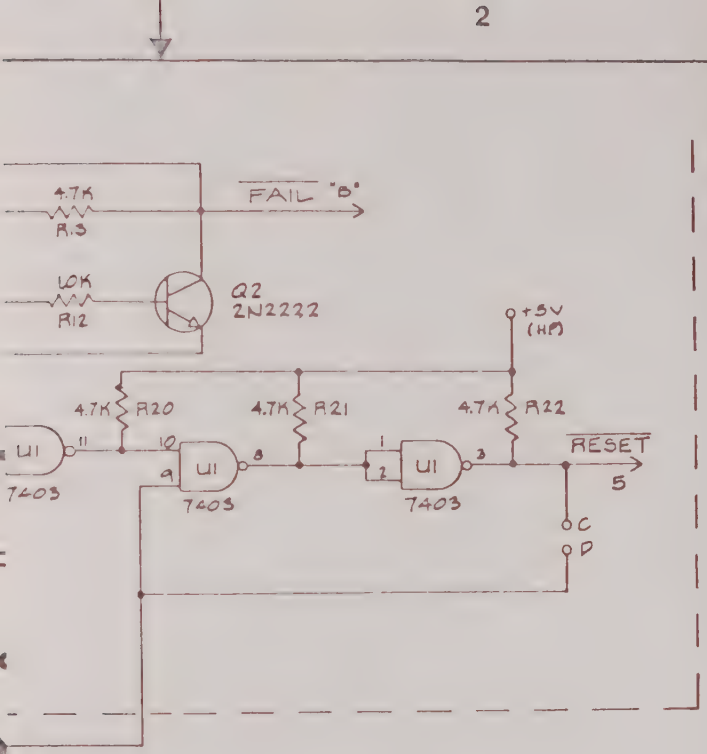
A24 OHM SENSE BOARD
ASSEMBLY DRAWING

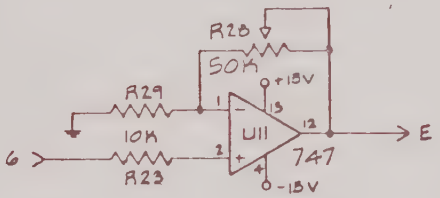
SIZE C | DWG. NO. 00434-02 | REV

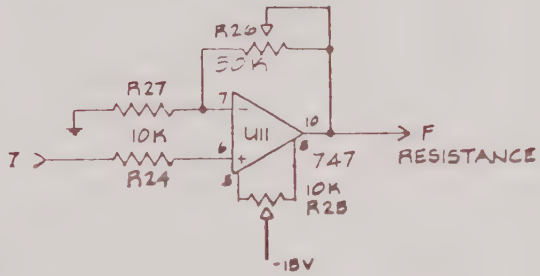
SCALE 2X | SHEET 1

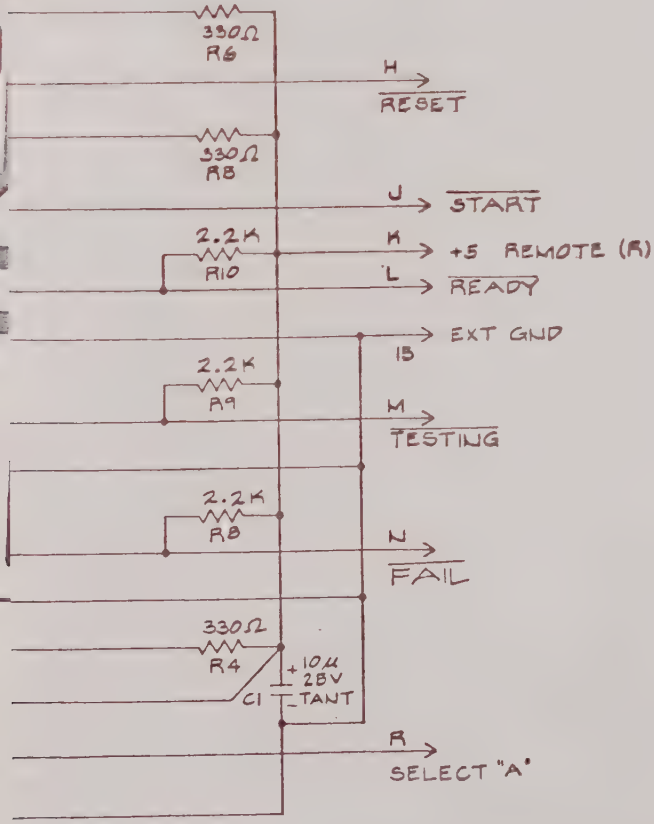
APPLICATION | DO NOT SCALE DRAWING


4
3
D
C
B
A
A
B
4.7K R17
20K R14
CR1 IN914
C3 .1µ 10V
.01µ C7
+5V (HP)
555 U5
J2
FAIL
+5V
-15V
+15V
74122 U4
.01µ C5
4.7K R19
U1
7403
330K R15
68µ 10V TANT C4
.01µ C6
1M R16
4.7K R18
HI-POT GROUND
AUTOMATIC RESET
H11B1 OR H11B3
U9
U10
7410
START
U2
+5V HIPOT (HP)
10µ 25V TANT C2
GROUND TEST
2.0K R3
U6
TESTING
2.0K R2
U7
2.0K R1
2.2K R11
U8
2N3904
Q1
1.0K R7
U9
K1
"A" TIME
"B" TIME
"A" RISE
"B" RISE
NC1
C1
NO1
NC2
C2
NO2
-15V









NOTES:

1. TO BYPASS AUTOMATIC RESET CIRCUITRY
   - A. ADD JUMPERS A,B;C,D
   - B. DELETE COMPONENTS:
     - U1, U4, U5
     - C3, C4, C5, C6
     - CR1
     - Q2
     - R12 - R22
2. TO BYPASS MONITORING DELETE COMPONENTS:
   - U11
   - R23 - R29
3. FOR GND TESTER
   - DELETE K1
   - USE MONITORING

THIS DRAWING REPLACES DRAWING # 00276-01.

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	F	CHANGED REV. LEVEL TO AGREE WITH FABRICATION & ASSEMBLY DRWGS.	4-23-84	BILL

QTY REQD	FSCM NO	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS ± ANGLES ±
.XX ± .01
.XXX ± .005

CONTRACT NO.

ELECTRONICS, INC. 1288 HAMILTON COURT · MENLO PARK, CALIFORNIA 94025 · (415) 323-0711

APPROVALS	DATE
DRAWN JUN	3-14-84
CHECKED	4-16-84
DES. ENGR.	
PROJ. ENGR.	

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

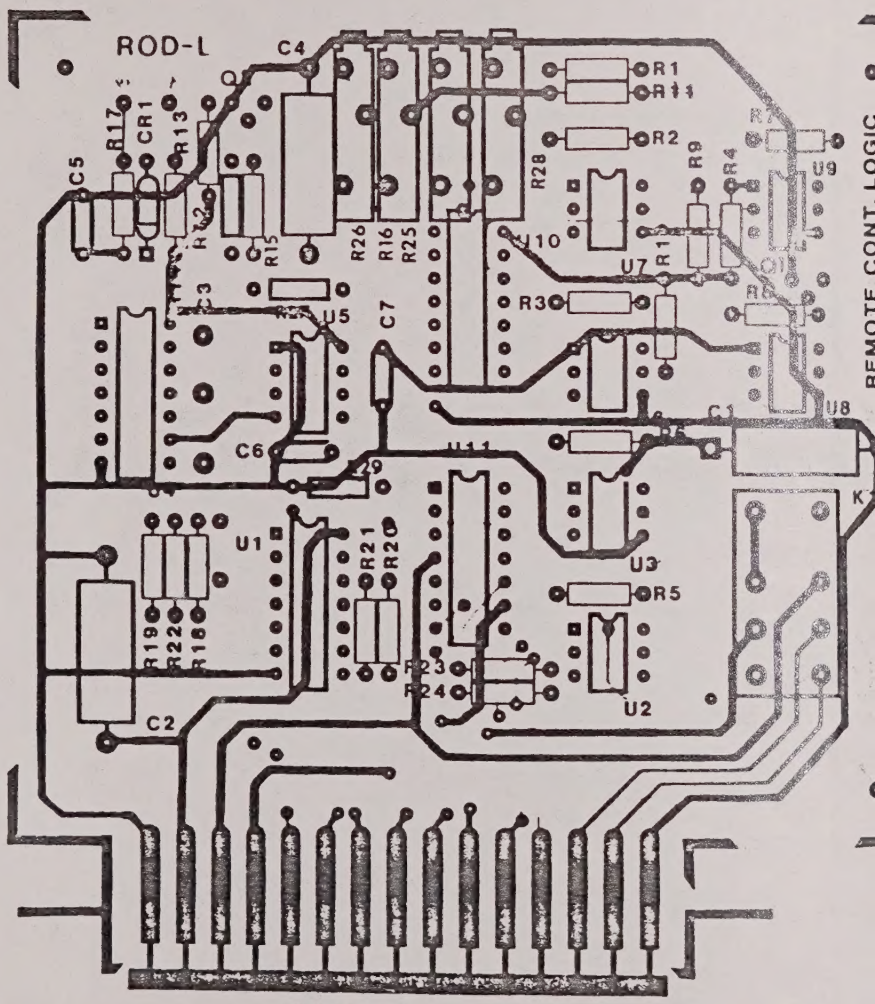
REMOTE CONTROL LOGIC WITH AUTOMATIC RESET OPTION

SIZE C | FSCM NO. | DWG. NO. 00445-01 | REV. F

SCALE | SHEET

DWG. NO. | SH | REV.

REDUCE TO 5.500±.002



COMPONENT SIDE

SILKSCREEN

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

AUTOMATIC RESET OPTION

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

USED ON

N

CONTRACT NO.

APPROVALS	DATE
DRAWN LE	4/84
CHECKED	

RODL ELECTRONICS, INC.

A8 REMOTE / AUTO RESET ASSEMBLY DRAWING

SIZE	CODE IDENT NO	DRAWING NO.	REV
C		00445-02	F

SCALE 2X SHEET 1 OF 1